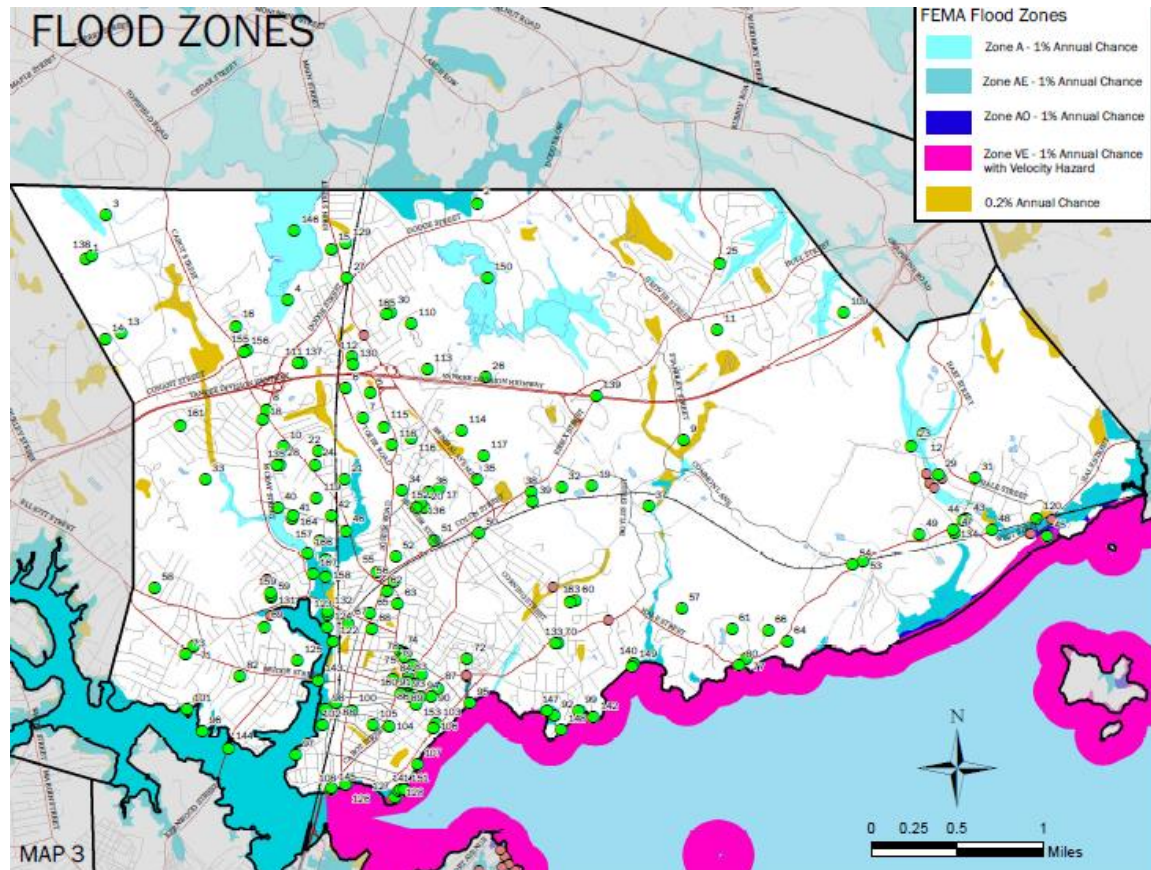


CITY OF BEVERLY HAZARD MITIGATION PLAN 2012 UPDATE



**Final Plan
Adopted February, 6, 2012**

**CITY OF BEVERLY HAZARD MITIGATION PLAN
2012 UPDATE**

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CITY OF BEVERLY HAZARD MITIGATION PLAN 2012 UPDATE

ACKNOWLEDGEMENTS AND CREDITS

This plan was prepared for the City of Beverly by the Metropolitan Area Planning Council (MAPC) under the direction of the Massachusetts Emergency Management Agency (MEMA) and the Massachusetts Department of Conservation and Recreation (DCR). The plan was funded by the Federal Emergency Management Agency's (FEMA) Pre-Disaster Mitigation (PDM) Grant Program.

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**CITY OF BEVERLY HAZARD MITIGATION PLAN
2012 UPDATE**

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**CITY OF BEVERLY HAZARD MITIGATION PLAN
2012 UPDATE**

TABLE OF CONTENTS

	Section	Page
I.	Executive Summary	1
II.	Introduction	3
III.	Public Participation	9
IV.	Risk Assessment	12
V.	Hazard Mitigation Goals	39
VI.	Existing Mitigation Measures	41
VII.	Mitigation Measures from the 2005 Plan	49
VIII.	Hazard Mitigation Strategy	51
IX.	Plan Adoption and Maintenance	63
X.	List of References	65
Appendix A	Meeting Agendas	67
Appendix B	Hazard Mapping	71
Appendix C	Documentation of Public Participation	77
Appendix D	Documentation of Plan Adoption	79

LIST OF TABLES

Table #	Table	Page
1	Plan Review and Update	2
2	Previous Federal/State Disaster Declarations	4
3	FEMA-Funded Mitigation Projects	6
4	Attendance at the Beverly Local Committee Meetings	10
5	Attendance at Public Meetings	10
6	Hazard Risks Summary	12
7	Repetitive Loss Properties Summary	15
8	2005 Land Use	19
9	Relationship of Potential Development Parcels to Hazard Areas	21
10	Relationship of Critical Infrastructure to Hazard Areas	23
11	Estimated Damages from Hurricanes	34
12	Estimated Damages from Earthquakes	35
13	Estimated Damages from Flooding	37
14	Existing Mitigation Measures	47
15	Mitigation Measures from the 2005 Plan	49
16	Potential Mitigation Measures	58

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CITY OF BEVERLY HAZARD MITIGATION PLAN 2012 UPDATE

I. EXECUTIVE SUMMARY

Hazard Mitigation planning is a proactive effort to identify actions that can be taken to reduce the dangers to life and property from natural hazard events. In the communities of the Boston region of Massachusetts, hazard mitigation planning tends to focus most on flooding, the most likely natural hazard to impact these communities. The Federal Disaster Mitigation Act of 2000 requires all municipalities that wish to be eligible to receive FEMA funding for hazard mitigation grants, to adopt a local multi-hazard mitigation plan and update this plan in five year intervals.

Planning Process

Planning for the Beverly Hazard Mitigation Plan update was led by the Beverly Local Hazard Mitigation Planning Committee, composed of staff from a number of different City Departments. This committee discussed where the impacts of natural hazards most affect the City, goals for addressing these impacts, and hazard mitigation measures that would benefit the City.

Public participation in this planning process is important for improving awareness of the potential impacts of natural hazards and to build support for the actions the City takes to mitigate them. Two public meetings were held, the first on September 13 and the second on date and the plan was posted on the City's website for public review.

Risk Assessment

The plan update provides risk assessment for the following natural hazards in Beverly: flooding, wind, winter storms, and fire

Hazard Mitigation Goals

1. Ensure that critical infrastructure sites are protected from natural hazards.
2. Protect existing residential and business areas from flooding.
3. Maintain existing mitigation infrastructure in good condition.
4. Continue to enforce existing zoning and building regulations.
5. Educate the public about zoning and building regulations, particularly with regard to changes in regulations that may affect tear-downs and new construction.
6. Work with surrounding communities to ensure regional cooperation and solutions for hazards affecting multiple communities such as coastal erosion.
7. Encourage future development in areas that are not prone to natural hazards.

CITY OF BEVERLY HAZARD MITIGATION PLAN 2012 UPDATE

8. Educate the public about natural hazards and mitigation measures.
9. Make efficient use of public funds for hazard mitigation.
10. Protect the City's ability to respond to various natural hazard events.

Potential Hazard Mitigation Actions

- Adding more flood storage capacity at Chubb Brook
- Purchasing excavator with grapple to clear tree and debris following storm events
- Installing a Bass River tide gate
- Purchasing trailer-mounted, multi-phase generator for sewer pump station backup

Plan Review and Update Process

Table 1 Plan Review and Update

Chapter	Reviews and Updates
III – Public Participation	The Beverly Local Committee placed an emphasis on public participation for the update of the Hazard Mitigation Plan, discussing strategies to enhance participation opportunities at the first local committee meeting. During plan development, the plan was presented to the Planning Board and the City Council in public meetings. The City Council's meeting was televised. The plan was also available on the City's website for public comment.
IV – Risk Assessment	MAPC gathered the most recently available hazard and land use data and met with City staff to identify changes in local hazard areas and development trends. City staff reviewed critical infrastructure with MAPC staff in order to create an up-to-date list. MAPC also used the most recently available version of HAZUS and assessed the potential impacts of flooding using the latest data.
V - Goals	The Hazard Mitigation Goals were reviewed and endorsed by the Local Hazard Mitigation Committee. .
VI – Existing Mitigation Measures	The list of existing mitigation measures was updated to reflect current mitigation activities in the City.
VII & VIII – Hazard Mitigation Strategy	Mitigation measures from the 2005 plan were reviewed and assessed as to whether they were completed, on-going, or deferred. The Local Committee determined whether to carry forward measures into the 2010 plan or delete them. The 2010 Hazard Mitigation Strategy reflects both new measures and measures carried forward from the 2005 plan. The Committee re-prioritized all of these measures based on current conditions.
IX – Plan Adoption &	This section of the plan was updated with a new on-going plan implementation review and five year update process that will assist

**CITY OF BEVERLY HAZARD MITIGATION PLAN
2012 UPDATE**

Maintenance	the City in incorporating hazard mitigation issues into other City planning and regulatory review processes and better prepare the City to update the plan in 2016.
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As indicated on Table 15, Beverly made considerable progress on implementing mitigation measures identified in the 2005 Hazard Mitigation Plan. Many of the measures identified in that plan are now considered on-going aspects of the regular work of City staff from the department head level to the regular work of Public Works staff. Individual projects have been incorporated into the City's capital improvement plan and the City continues to seek FEMA grant funding to implement the home elevation program. Moving forward into the next five year plan implementation period there will be many more opportunities to incorporate hazard mitigation into the City's decision making processes.

CITY OF BEVERLY HAZARD MITIGATION PLAN 2012 UPDATE

II. INTRODUCTION

Planning Requirements under the Federal Disaster Mitigation Act

The Federal Disaster Mitigation Act, passed in 2000, requires that after November 1 2004, all municipalities that wish to continue to be eligible to receive FEMA funding for hazard mitigation grants, must adopt a local multi-hazard mitigation plan and update this plan in five year intervals. This planning requirement does not affect disaster assistance funding.

Massachusetts has taken a regional approach and has encouraged the regional planning agencies to apply for grants to prepare plans for groups of their member communities. The Metropolitan Area Planning Council (MAPC) received a grant from the Federal Emergency Management Agency (FEMA) under the Pre-Disaster Mitigation (PDM) Program, to assist the City of Beverly and eight other North Shore communities to update their local Hazard Mitigation Plans, which were first adopted in as part of a North Shore Multi-Jurisdictional Hazard Mitigation Plan. The local Hazard Mitigation Plan updates produced under this grant are designed to individually meet the requirements of the Disaster Mitigation Act for each community.

In order to address multijurisdictional and regional issues, the participating municipalities were afforded the opportunity to meet with their neighboring communities during plan development, and MAPC has also produced a regional document that summarizes the issues and recommendations for the North Shore communities.

What is a Hazard Mitigation Plan?

Natural hazard mitigation planning is the process of determining how to systematically reduce or eliminate the loss of life and property damage resulting from natural hazards such as floods, earthquakes, and hurricanes. Hazard mitigation means to permanently reduce or alleviate the losses of life, injuries, and property resulting from natural hazards through long-term strategies. These long-term strategies include planning, policy changes, programs, projects, and other activities.

Previous Federal/State Disasters

The City of Beverly has experienced 17 natural hazards that triggered federal or state disaster declarations since 1991. These are listed in Table 2 below. The vast majority of these events involved flooding.

**CITY OF BEVERLY HAZARD MITIGATION PLAN
2012 UPDATE**

Table 2 Previous Federal/State Disaster Declarations

DISASTER NAME (DATE OF EVENT)	TYPE OF ASSISTANCE	DECLARED AREAS
Hurricane Bob (August 1991)	FEMA Public Assistance Project Grants	Counties of Barnstable, Bristol, Dukes, Essex, Hampden, Middlesex, Plymouth, Nantucket, Norfolk, Suffolk
	Hazard Mitigation Grant Program	Counties of Barnstable, Bristol, Dukes, Essex, Hampden, Middlesex, Plymouth, Nantucket, Norfolk, Suffolk (16 projects)
No-Name Storm (October 1991)	FEMA Public Assistance Project Grants	Counties of Barnstable, Bristol, Dukes, Essex, Middlesex, Plymouth, Nantucket, Norfolk
	FEMA Individual Household Program	Counties of Barnstable, Bristol, Dukes, Essex, Middlesex, Plymouth, Nantucket, Norfolk
	Hazard Mitigation Grant Program	Counties of Barnstable, Bristol, Dukes, Essex, Middlesex, Plymouth, Nantucket, Norfolk, Suffolk (10 projects)
December Blizzard (December 1992)	FEMA Public Assistance Project Grants	Counties of Barnstable, Dukes, Essex, Plymouth, Suffolk
	Hazard Mitigation Grant Program	Counties of Barnstable, Dukes, Essex, Plymouth, Suffolk (7 projects)
March Blizzard (March 1993)	FEMA Public Assistance Project Grants	All 14 Counties
January Blizzard (January 1996)	FEMA Public Assistance Project Grants	All 14 Counties
May Windstorm (May 1996)	State Public Assistance Project Grants	Counties of Plymouth, Norfolk, Bristol (27 communities)

**CITY OF BEVERLY HAZARD MITIGATION PLAN
2012 UPDATE**

DISASTER NAME (DATE OF EVENT)	TYPE OF ASSISTANCE	DECLARED AREAS
October Flood (October 1996)	FEMA Public Assistance Project Grants	Counties of Essex, Middlesex, Norfolk, Plymouth, Suffolk
	FEMA Individual Household Program	Counties of Essex, Middlesex, Norfolk, Plymouth, Suffolk
	Hazard Mitigation Grant Program	Counties of Essex, Middlesex, Norfolk, Plymouth, Suffolk (36 projects)
1997	Community Development Block Grant-HUD	Counties of Essex, Middlesex, Norfolk, Plymouth, Suffolk
June Flood (June 1998)	FEMA Individual Household Program	Counties of Bristol, Essex, Middlesex, Norfolk, Suffolk, Plymouth, Worcester
	Hazard Mitigation Grant Program	Counties of Bristol, Essex, Middlesex, Norfolk, Suffolk, Plymouth, Worcester (19 projects)
(1998)^	Community Development Block Grant-HUD	Counties of Bristol, Essex, Middlesex, Norfolk, Suffolk, Plymouth, Worcester
March Flood (March 2001)	FEMA Individual Household Program	Counties of Bristol, Essex, Middlesex, Norfolk, Suffolk, Plymouth, Worcester
	Hazard Mitigation Grant Program	Counties of Bristol, Essex, Middlesex, Norfolk, Suffolk, Plymouth, Worcester (16 projects)
February Snowstorm (Feb 17-18, 2003)	FEMA Public Assistance Project Grants	All 14 Counties
January Blizzard (January 22-23, 2005)	FEMA Public Assistance Project Grants	All 14 Counties
Hurricane Katrina (August 29, 2005)	FEMA Public Assistance Project Grants	All 14 Counties
May Rainstorm/Flood (May 12-23, 2006)	Hazard Mitigation Grant Program	Statewide

**CITY OF BEVERLY HAZARD MITIGATION PLAN
2012 UPDATE**

DISASTER NAME (DATE OF EVENT)	TYPE OF ASSISTANCE	DECLARED AREAS
April Nor'easter (April 15-27, 2007)	FEMA Public Assistance Project Grants	Barnstable, Berkshire, Dukes, Essex, Franklin, Hampden, Hampshire, Plymouth
	Hazard Mitigation Grant Program	Statewide
Flooding (March, 2010)	FEMA Public Assistance FEMA Individuals and Households Program SBA Loan	Bristol, Essex, Middlesex, Suffolk, Norfolk, Plymouth, Worcester
	Hazard Mitigation Grant Program	Statewide

(Source: database provided by MEMA)

FEMA Funded Mitigation Projects

Over the last 20 years the City of Beverly has received funding from FEMA for two mitigation projects under the Hazard Mitigation Grant Program. These projects totaled more than \$249,879, with \$241,879 covered by FEMA grants and \$8,000 by local funding. The projects are summarized in Table 3 below.

Table 3 FEMA-Funded Mitigation Projects
(Utilizing the Hazard Mitigation Grant Program)

Year	Project Title	Scope of Work	Total Cost	Federal Funding	Local Funding
2003	Chase St. Drainage Improvement	To replace an old and obsolete storm water drainage system in the Chase St. area.	\$217,879.00	\$217,879.00	\$0.00
2006	West& Hale St, & Dix Park Drainage Improvement Design	Design services for drainage improvements and flood control measures around Hale Street and Dix Park.	\$32,000.00	\$24,000.00	\$8,000.00

(Source: database provided by MEMA)

CITY OF BEVERLY HAZARD MITIGATION PLAN 2012 UPDATE

Community Profile

Founded in 1626, the City of Beverly is one of the oldest communities in the state. Residents describe their City as the birthplace of the United States Navy, noting that the first ship commissioned by the Navy first sailed from Beverly Harbor. Although the City was the location of the first cotton mill and the first Sunday school in the country, and has one of its neighborhoods, the Fish Flake District, on the National Register of Historic sites, it is the present and future rather than the past which engross the energies of the community. Beverly residents have watched an interesting shift over the past 50 years, as the City changed from an industrial site with huge manufacturers like the United Shoe Machine Corporation, to a bedroom community that is 85% residential and emphasizes its academic and cultural facilities more than the industrial parks that house mixed computer and other high technology firms. The City is the home of private Endicott College and a campus of the public North Shore Community College as well as the site of the North Shore Music Theatre, which brings in hordes of visitors to glittering Broadway-type productions. Intact in Beverly is the spacious echo of the past since the City is still the home of some of the most historic families in America on gracious estates in the northern portion of the community. Residents note the first-rate hospital, the miles of beautiful beach, and the diverse sections of the community that offer everything from rural to urban lifestyles in saying that the City offers everything that anyone could want in a home town. (MA DHCD profile)

The town maintains a website at <http://www.beverlyma.gov/> .

**CITY OF BEVERLY HAZARD MITIGATION PLAN
2012 UPDATE**

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CITY OF BEVERLY HAZARD MITIGATION PLAN 2012 UPDATE

III. PUBLIC PARTICIPATION

Public participation occurred at two levels; the North Shore Multiple Hazard Community Planning Team (regional committee) and the Beverly Multiple Hazard Community Planning Team (local committee). In addition, the City held one meeting open to the general public to present the plan and hear citizen input.

Beverly's Participation in the Regional Committee

On January 15, 2010, a letter was sent notifying the communities of the first meeting of the North Shore Regional Committee and requesting that the Chief Elected Official designate a minimum of two municipal employees and/or officials to represent the community. The following individuals were appointed to represent Beverly on the regional committee:

Mike Collins	Department of Public Works (DPW) Director
Mark Foster	Emergency Management Director
Roland Adams	GIS Director

The North Shore Regional Committee met on the following dates:

February 8, 2010

The Local Multiple Hazard Community Planning Team

In addition to the regional committee meetings, MAPC worked with the local community representatives to organize a local Multiple Hazard Community Planning Team for Beverly (local committee). MAPC briefed the local representatives as to the desired composition of that team as well as the need for representation from the business community and citizens at large.

The Local Multiple Hazard Community Planning Team Meetings

On August 2, 2010 MAPC conducted the meeting of the Beverly Local Committee. The meeting was organized by Mark Foster, Emergency Management Director. The purpose of the meeting was to review the existing plan and mitigation goals, including gathering information on local hazard mitigation issues, updating existing mitigation practices, and determining the status of mitigation measures from the 2005 plan. The meeting also included discussion of new or modified mitigation measures and a process for public involvement and outreach. Table 4 lists the attendees at each meeting of the team. The agenda for these meeting is included in Appendix A.

CITY OF BEVERLY HAZARD MITIGATION PLAN 2012 UPDATE

Table 4
Attendance at the Beverly Local Committee Meeting

Name	Representing
<i>August 2, 2010</i>	
Mark Foster	Emergency Management Director
Roland Adams	GIS Director
Tina Cassidy	Planning Director
Amy Maxner	Environmental Planner

Public Meetings

The plan was introduced to the public at two public meetings, both while the draft plan was being completed. The public had an opportunity to provide input to the planning process during a meeting of the Beverly Planning Board on October 19, 2010 held in the Beverly City Hall. The draft plan was also presented for public comment at a meeting of the Beverly City Council on October 18, 2010 at the City Hall.

Both the Planning Board and City Council meetings were advertised as public meetings. The attendance list for each meeting can be found in Table 5. In addition, the plan was made available on the City's website for public review.

Table 5
Attendance at Public Meetings

Name	Representing
<i><u>First Public Meeting</u></i>	
Michael P. Cahill, Chair	Beverly City Council
Patricia Grimes	Beverly City Council
Paul Guanci	Beverly City Council
Kevin Hobin	Beverly City Council
James F. Latter	Beverly City Council
David Martin	Beverly City Council
Wesley Slate, Jr.	Beverly City Council
Sam Cleaves	MAPC
Martin Pillsbury	MAPC
<i><u>Second Public Meeting</u></i>	
Richard Dinkin, Chair	Planning Board
Joanne Dunn	Planning Board
Charles Harris	Planning Board
Ellen Hutchinson	Planning Board
David Mack	Planning Board
James Mack	Planning Board
John Thomson, Vice Chair	Planning Board
Sam Cleaves	MAPC

**CITY OF BEVERLY HAZARD MITIGATION PLAN
2012 UPDATE**

Other Opportunities for Public Involvement

The draft plan was posted on the City's website for 10 days for public comment during November 2010. The posting was announced at both the City Council and Planning Board meeting. The City Council meeting was televised.

CITY OF BEVERLY HAZARD MITIGATION PLAN 2012 UPDATE

IV. RISK ASSESSMENT

The risk assessment analyzes the potential natural hazards that could occur within the City of Beverly as well as the relationship between those hazards and current land uses, potential future development, and critical infrastructure. This section also includes a vulnerability assessment that estimates the potential damages that could result from certain large scale natural hazard events.

Update Process

In order to update Beverly's risk assessment, MAPC gathered the most recently available hazard and land use data and met with City staff to identify changes in local hazard areas and development trends. City staff reviewed critical infrastructure with MAPC staff in order to create an up-to-date list. MAPC also used the most recently available version of HAZUS (described below) and assessed the potential impacts of flooding using the latest data.

Overview of Hazards and Impacts

The Massachusetts Hazard Mitigation Plan 2007 (state plan) provides an in-depth overview of natural hazards in Massachusetts. The state plan indicates that Massachusetts is subject to the following natural hazards (listed in order of frequency); floods, heavy rainstorms, nor'easters or winter storms, coastal erosion, hurricanes, tornadoes, urban and wildfires, drought and earthquakes. Previous state and federal disaster declarations since 1991 are summarized in Table 1.

Table 6 summarizes the hazard risks for Beverly. This evaluation takes into account the frequency of the hazard, historical records, and variations in land use. This analysis is based on the vulnerability assessment in the Commonwealth of Massachusetts State Hazard Mitigation Plan, 2007. The statewide assessment was modified to reflect local conditions in Beverly using the definitions for hazard frequency and severity listed below Table 6.

**Table 6
Hazard Risks Summary**

Hazard	Frequency	Severity
Flooding	High	Serious
Winter storms	High	Serious
Hurricanes	Medium	Serious
Earthquakes	Low	Extensive
Tornadoes	Low	Serious
Landslides	Low	Minor
Brush fires	Medium	Minor
Dam failures	Low	Serious

CITY OF BEVERLY HAZARD MITIGATION PLAN 2012 UPDATE

Definitions used in the Commonwealth of Massachusetts State Hazard Mitigation Plan

Frequency

Very low frequency: events that occur less frequently than once in 1,000 years (less than 0.1% per year)

Low frequency: events that occur from once in 100 years to once in 1,000 years (0.1% to 1% per year);

Medium frequency: events that occur from once in 10 years to once in 100 years (1% to 10% per year);

High frequency: events that occur more frequently than once in 10 years (greater than 10% per year).

Severity

Minor: Limited and scattered property damage; no damage to public infrastructure (roads, bridges, trains, airports, public parks, etc.); contained geographic area (i.e. one or two communities); essential services (utilities, hospitals, schools, etc) not interrupted; no injuries or fatalities.

Serious: Scattered major property damage (more than 50% destroyed); some minor infrastructure damage; wider geographic area (several communities); essential services are briefly interrupted; some injuries and/or fatalities.

Extensive: Consistent major property damage; major damage public infrastructure damage (up to several days for repairs); essential services are interrupted from several hours to several days; many injuries and fatalities.

Catastrophic: Property and public infrastructure destroyed; essential services stopped, thousands of injuries and fatalities.

Flood Related Hazards

Flooding was the most prevalent serious natural hazard identified by local officials in Beverly. Flooding is generally caused by hurricanes, nor'easters, severe rainstorms, and, thunderstorms. Sea level rise has the potential to exacerbate these issues over time.

Regionally Significant Storms

There have been a number of major floods that have affected the North Shore region over the last fifty years. Significant historic flood events in Beverly have included:

March 1968

The blizzard of 1978

January 1979

April 1987

October 1991 ("The Perfect Storm")

October 1996

June 1998

March 2001

April 2004

May 2006

April 2007

March 2010

Overview of City-Wide Flooding

The City of Beverly is subject to two kinds of flooding; coastal flooding where wind and tide leads to flooding along the shore and tidal waterways and inland flooding where the rate of precipitation or amount of water overwhelms the capacity of natural and structured drainage systems to convey water causing it to overflow the system. These two types of flooding are often combined as inland flooding is prevented from draining by the push of wind and tide driven water. Both types of flooding can be caused by major storms, known as northeasters and hurricanes. Northeasters can occur at any time of the year but they are most common in winter. Hurricanes are most common in the summer and early fall. Northeasters cover a larger area than hurricanes although the winds are not as high. They also generally last long enough to include at least one high tide, which causes the most severe flooding. Large rain storms or snowfalls can also lead to inland flooding.

Information on flood hazard areas was taken from two sources. The first was the National Flood Insurance Rate Maps. The FIRM flood zones are shown on Map 3 in Appendix B. The second was discussions with local officials. The Locally Identified Areas of Flooding described below were identified by City staff as areas where flooding is known to occur. These areas do not necessarily coincide with the flood zones from the FIRM maps. They may be areas that flood due to inadequate drainage systems or other local conditions rather than location within a flood zone. The numbers correspond to the numbers on Map 8, "Hazard Areas". The numbers do not reflect priority order.

Locally Identified Areas of Flooding

- 1) North Beverly Brook: mostly completed as of 2010: flooding
- 2) Lawrence Street Brook: some work completed since 2005: flooding
- 3) Chubb Creek: flooding
- 7) Water Street: coastal flooding
- 8) Millbrook Road: flooding
- 13) Bayview Seawall: coastal flooding/storms
- 15) Tide gate at head of Bass River: coastal flooding/storms
- 17) Tide Gate at Bass River: coastal flooding /storms

Repetitive Loss Structures

There are 15 repetitive loss structures in Beverly, an increase from the 9 structures identified in the 2005 plan. As defined by the Community Rating System (CRS) of the National Flood Insurance Program (NFIP), a repetitive loss property is any property which the NFIP has paid two or more flood claims of \$1,000 or more in any given 10-year period since 1978. For more information on repetitive losses see <http://www.fema.gov/business/nfip/replps.shtm>.

CITY OF BEVERLY HAZARD MITIGATION PLAN 2012 UPDATE

Beverly's repetitive loss properties consist of twelve single-family residential structures with two 2-4 family structures and one non-residential structure

Table 7
Repetitive Loss Properties Summary

Structure Type	FEMA Flood Zone	Locally Identified Flooding Area
Single-Family	Zone AE	No
Single-Family	Zone AE	No
Single-Family	Zone AE	No
Single-Family	No	No
Single-Family	Zone A	No
Single-Family	Zone AE	No
Single-Family	No	No
Single-Family	No	No
Single-Family	No	No
Single-Family	Zone X500	No
Single-Family	Zone AE	No
Single-Family	Zone A	No
2-4 Family	No	No
2-4 Family	No	No
Non residential	Zone A	No

Dams and Dam Failure

The Department of Conservation and Recreation (DCR) Office of Dam Safety lists four dams in Beverly. Two of the dams are rated as low hazard or non-jurisdictional, and two are rated as being significant hazards.

Dam failure can arise from two types of situations. Dams can fail because of structural problems independent of any storm event. Dam failure can follow an earthquake by causing structural damage. Dams can fail structurally because of flooding arising from a storm or they can overspill due to flooding.

In the event of a dam failure, the energy of the water stored behind even a small dam can cause loss of life and property damage if there are people or buildings downstream. The number of fatalities from a dam failure depends on the amount of warning provided to the population and the number of people in the area in the path of the dam's floodwaters.

The Beverly Comprehensive Emergency Management Plan has a section on dam failure. The plan notes that dam failure in general is infrequent but has the potential for severe impacts. An issue for dams in Massachusetts is that many were built in the 19th century without the benefits of modern engineering or construction oversight.

The Massachusetts DCR has three hazard classifications for dams:

CITY OF BEVERLY HAZARD MITIGATION PLAN 2012 UPDATE

- High Hazard:** Dams located where failure or mis-operation will likely cause loss of life and serious damage to home(s), industrial or commercial facilities, important public utilities, main highway(s) or railroad(s).
- Significant Hazard:** Dams located where failure or mis-operation may cause loss of life and damage home(s), industrial or commercial facilities, secondary highway(s) or railroad(s) or cause interruption of use or service of relatively important facilities.
- Low Hazard:** Dams located where failure or mis-operation may cause minimal property damage to others. Loss of life is not expected.

In general, DCR requires that dams that are rated as low hazard be inspected every ten years while dams that are rated as significant hazards must be inspected every five years.

Shoe Pond Dams – These two dams are on the Bass River. They are near the former United Shoe property, now the home of the Cummings Center. These dams are rated as non-jurisdictional by DCR. There is a low probability of loss of life downstream if either of these dams broke, with some property damage.

Longham Reservoir- The reservoir and dam are owned by the Salem-Beverly Water Board and are principally located in Wenham. The dam is broad and earthen. Rated as non jurisdictional by DCR, the dam would flood an adjacent meadow if it broke and property damage would most likely be minimal.

Wind Related Hazards

Wind-related hazards include hurricanes and tornadoes as well as high winds during severe rainstorms and thunderstorms. As with many communities, falling trees that result in downed power lines and power outages are an issue in Beverly.

Between 1858 and 2000, Massachusetts has experienced approximately 32 tropical storms, nine Category 1 hurricanes, five Category 2 hurricanes and one Category 3 hurricane. This equates to a frequency of once every six years. A hurricane or storm track is the line that delineates the path of the eye of a hurricane or tropical storm. There have been no recorded hurricane or tropical storm tracks through Beverly. However, the City does experience the impacts of the wind and rain of hurricanes and tropical storms regardless of whether the storm track passed through the City.

The hazard mapping indicates that the 100 year wind speed is 110 miles per hour. There has been no recorded tornado within the City limits.

Information on wind related hazards can be found on Map 5 in Appendix B.

CITY OF BEVERLY HAZARD MITIGATION PLAN 2012 UPDATE

Winter Storms

In Massachusetts, northeast coastal storms known as nor'easters occur 1-2 times per year. Winter storms are a combination hazard because they often involve wind, ice and heavy snow fall. The average annual snowfall for most of the City is 36.1 - 48 inches.

The most significant winter storm in recent history was the "Blizzard of 1978," which resulted in over 3 feet of snowfall and multiple day closures of roadways, businesses, and schools. Historically, severe winter storms have occurred in the following years:

Blizzard of 1978	February 1978
Blizzard	March 1993
Blizzard	January 1996
Severe Snow Storm	March 2001
Severe Snow Storm	December 2003
Severe Snow Storm	January 2005

More recently, 2008 was a record year for snowfall. By the end of the February 2008, Boston's Logan International Airport broke a new February record for total precipitation. In March 2008, many cities and towns in Massachusetts exceeded the highest snowfall records. The above-average snowfall that season increased groundwater and surface water levels to a high level, and contributed to flooding experienced in spring 2008.

Information on winter storm related hazards can be found on Map 6 in Appendix B.

Fire Related Hazards

The Beverly Fire Department responds to approximately five woods, brush, and grass fires of varying sizes annually. Within the past year there were no wildfires that resulted in significant property damage. Beverly's wildfires tend to be in the more remote wooded areas. The most common cause of these fires has been unattended children playing with matches and campfires. The following areas of City were identified as having the highest potential for brush fires. The numbers correspond to the numbers on Map 8, "Hazard Areas":

- 9) Land near Endicott College
- 10) Sally Mulligan Park area
- 11) Branch Lane area
- 12) Greenwood Avenue area

Geologic Hazards

Geologic hazards include earthquakes, landslides, sinkhole, subsidence, and unstable soils such as fill, peat, and clay. Although new construction under the most recent building codes generally will be built to seismic standards, there are still many structures

CITY OF BEVERLY HAZARD MITIGATION PLAN 2012 UPDATE

which pre-date the most recent building code. Information on geologic hazards can be found on Map 4 in Appendix B.

Earthquakes

According to the State Hazard Mitigation Plan, New England experiences an average of five earthquakes per year. From 1627 to 1989, 316 earthquakes were recorded in Massachusetts. Most have originated from the La Malbaie fault in Quebec or from the Cape Anne fault located off the coast of Rockport. The region has experienced larger earthquakes, of magnitude 6.0 to 6.5 in 1727 and 1755. Other notable earthquakes occurred here in 1638 and 1663 (Tufts University). There have been no recorded earthquake epicenters within Beverly.

Earthquake Impacts – Earthquakes are a hazard with multiple impacts beyond the obvious building collapse. Buildings may suffer structural damage which may or may not be readily apparent. Earthquakes can cause major damage to roadways, making emergency response difficult. Water lines and gas lines can break, causing flooding and fires. Another potential vulnerability is equipment within structures. For example, a hospital may be structurally engineered to withstand an earthquake, but if the equipment inside the building is not properly secured, the operations at the hospital could be severely impacted during an earthquake. Earthquakes can also trigger landslides.

Landslides

Landslides can result from human activities that destabilize an area or can occur as a secondary impact from another natural hazard such as flooding. In addition to structural damage to buildings and the blockage of transportation corridors, landslides can lead to sedimentation of water bodies.

The entire City has been classified as having a low risk for landslides.

Land Use and Development Trends

Existing Land Use

The most recent land use statistics available from the state are from aerial photography done in 2005. Table 8 shows the acreage and percentage of land in 21 categories. If the five residential categories are aggregated, residential uses make up 33.28 % of the area of the City (9,852.83) acres). The highest percentage is forested lands which comprises 34.78 % which is 3,426 acres.

**CITY OF BEVERLY HAZARD MITIGATION PLAN
2012 UPDATE**

**Table 8
2005 Land Use**

Land Type	Acres	Percent
Cropland	64.42	0.65
Pasture	42.82	0.43
Forest	3426	34.78
Wetland	276.56	2.8
Mining	0	0
Open Land	185.89	1.8
Participation Recreation	149	1.5
Spectator Recreation	0	0
Water-based Recreation	9.98	0.1
Multifamily Residential	392.23	3.98
High Density Residential	1109.88	11.26
Medium Density Residential	1288.7	13.08
Low Density Residential	488.83	4.96
Very Low Density Residential	227.98	2.33
Saltwater Wetland	37.66	0.38
Commercial	369	3.74
Industrial	196.1	2
Urban Open	16.01	0.16
Transportation	299.82	3.04
Waste Disposal	32.2	0.33
Water	156.57	1.59
Cranberry Bog	0	0
Power line	4.17	0.04
Saltwater Beach	56.5	0.58
Golf Course	107.98	1.09
Marina	13.9	0.14
Urban Public	296.82	3.01
Cemetery	70.61	0.72
Orchard	1.37	0.01
Nursery	16.16	0.16
Forested Wetland	492.03	4.99
Junkyards	0	0
Brush land/Succession	23.64	0.24
Total	9852.83	100

CITY OF BEVERLY HAZARD MITIGATION PLAN 2012 UPDATE

For more information on how the land use statistics were developed and the definitions of the categories, please go to <http://www.mass.gov/mgis/lus.htm>.

Economic Elements

While Beverly does not have a quantitative measure of the impact of specific businesses, industries, or areas on its local economic conditions, there are several economic drivers within the City that face potential damage during a coastal natural hazard flooding event. These were businesses located along the waterfront, most especially in the Water Street and Bass River areas.

Historic, Cultural, and Natural Resource Areas

The Local Committee identified several historic sites of cultural importance to the City, including the Balch House, the Cabot House/Beverly Historical Society, Fish Flake Hill, the Cabot Street Theatre, Hale Farm and the North Shore Music Theatre. These buildings and sites are located outside of the most significant hazard areas, away from the coast and floodplain areas.

Development Trends

MAPC projects that Beverly will essentially reach its maximum build out under existing zoning by 2020. The growth rate is projected to be about 1 percent per year between 2001 and 2020, adding about 19 percent to the housing stock and projecting an additional population increase of 6,335 persons by the year 2020. The City anticipates further new commercial and industrial development primarily from land located near Beverly Airport and land in central Beverly located adjacent to Route 128. Commercial redevelopment is expected to occur in the downtown areas bordering Cabot and Rantoul Streets and along the waterfront in the Ferry Landing and Ventron sites.

Recent and Potential Future Development

MAPC consulted with City staff to determine areas that have been or are likely to be developed in the future, defined for the purposes of this plan as a five year time horizon. These areas are shown on Map 2, "Potential Development" and are described below. The letter for each site corresponds to the letters on Map 2.

- A) Chapman's Corner: 17 acres, conventional subdivision, 32 houses, under construction
- B) Elderly Housing Project: 172 units, 12 acres
- C) Aero Manufacturing: building expansion, 4 acres, 78,900 SF building, permitting phase
- D) Twin Ice Rinks: 10 acres, conceptual stage
- E) Endicott College: new art center: built
- F) Endicott College: 2 new dorms: built

CITY OF BEVERLY HAZARD MITIGATION PLAN 2012 UPDATE

- G) Landmark School: new gym: built
- H) Endicott College: new dorm and conference center: built
- I) Beaver Pond Development: existing lots ANR, 2 houses, 5 acres: built
- J) CEA Group: commercial development, fully permitted
- K) Vitale Property: industrial condominiums: built

Future Development in Hazard Areas

Table 9 shows the relationship of these parcels to two of the mapped hazards. This information is provided so that planners can ensure that development proposals comply with flood plain zoning and that careful attention is paid to drainage issues.

Table 9: Relationship of Potential Development to Hazard Areas

ID	Parcel	Landslide risk	Flood Zone
A	Chapman's Corner	Low	No
B	Elderly Housing Project	Low	No
C	Aero Manufacturing: building expansion	Low	No
D	Twin Ice Rinks	Low	No
E	Endicott College: new art center	Low	No
F	Endicott College: 2 new dorms	Low	No
G	Landmark School: new gym	Low	No
H	Endicott College: new dorm and conference center	Low	No
I	Beaver Pond Development	Low	38.1132% in A
J	CEA Group	Low	No
K	Vitale Property	Low	No
L	Penny Lane	Low	4.0647% in A
M	Depot Crossing: mixed use	Low	No
N	Beverly Office LLC	Low	51.6562% in AE
O	MBTA Parking Garage	Low	No
P	Glover Wharf Marina	Low	23.4351% in AE
Q	Land at Route 128 and Brimball Ave. Interchange	Low	.0711% in A
R	YMCA Property	Low	No
S	Beverly School for the Deaf	Low	No

CITY OF BEVERLY HAZARD MITIGATION PLAN 2012 UPDATE

Critical Infrastructure in Hazard Areas

Critical infrastructure includes facilities that are important for disaster response and evacuation (such as emergency operations centers, fire stations, water pump stations, etc.) and facilities where additional assistance might be needed during an emergency (such as nursing homes, elderly housing, day care centers, etc.). These facilities are listed in Table 10 and are shown on all of the maps in Appendix B.

The purpose of mapping the natural hazards and critical infrastructure is to present an overview of hazards in the community and how they relate to critical infrastructure, to better understand which facilities may be vulnerable to particular natural hazards.

Explanation of Columns in Table 10.

Column 1: ID #: The first column in Table 8 is an ID number which appears on the maps that are part of this plan. See Appendix B.

Column 2: Name: The second column is the name of the site. If no name appears in this column, this information was not provided to MAPC by the community.

Column 3: Type: The third column indicates what type of site it is.

Column 4: Landslide Risk: The fourth column indicates the degree of landslide risk for that site. This information came from NESEC. The landslide information shows areas with either a low susceptibility or a moderate susceptibility to landslides based on mapping of geological formations. This mapping is highly general in nature. For more information on how landslide susceptibility was mapped, refer to <http://pubs.usgs.gov/pp/p1183/pp1183.html>.

Column 5: FEMA Flood Zone: The fifth column addresses the risk of flooding. A "No" entry in this column means that the site is not within any of the mapped risk zones on the Flood Insurance Rate Maps (FIRM maps). If there is an entry in this column, it indicates the type of flood zone as follows:

Column 6: Locally-Identified Flood Area: The locally identified areas of flooding were identified by town staff as areas where flooding occurs. These areas do not necessarily coincide with the flood zones from the FIRM maps. They may be areas that flood due to inadequate drainage systems or other local conditions rather than location within a flood zone. The numbers correspond to the numbers on Map 8, "Hazard Areas".

Table 10: Relationship of Critical Infrastructure to Hazard Areas							
ID	NAME	TYPE	Landslide	Within FEMA Flood Zone	Locally IDed Area of Flooding	Avg. Annual Snow Fall	Surge Areas: Cat.#
1	Beverly Airport	Heliport		No		High	0
2	N Beverly Cemetery	Cemetery	Low	No	No	High	0
3	Beverly Emergency Mngt	EOC	Low	No	No	High	0
4	Salem-Beverly Water Supply Board	Hazmat	Low	A	No	High	0
5	Communications & Power Industry	Hazmat	Low	No	No	High	0
6	Signal Technology Corp	Hazmat	Low	No	North Beverly Brook	High	0
7	1. Tozer Road Children's Center	Day Care	Low	No	North Beverly Brook	High	0
8	North Beverly Fire Station	Fire Station	Low	No	No	High	0
9	Waring School	School	Low	No	No	High	0
10	Beverly Church Of The Nazarene	Church	Low	No	No	High	0
11	Centerville Elementary School	School	Low	No	No	High	0
12	Glen Urquhart	School	Low	A	Chubb Creek	High	0
13	Cp Clare Corp	Hazmat	Low	No	No	High	0
14	Axcelis Technologies Inc	Hazmat	Low	No	No	High	0
15	Beverly Bright Beginnings Ctr.	Day Care	Low	No	No	High	0
16	North Beverly Cemetery	Cemetery	Low	No	No	High	0
17	Herrick House	Assisted Living	Low	No	No	High	0
18	Henry's Of North Beverly	Supermarket	Low	No	No	High	0
19	Sons Of Abraham	Cemetery	Low	No	No	High	0

**CITY OF BEVERLY HAZARD MITIGATION PLAN
2012 UPDATE**

Table 10: Relationship of Critical Infrastructure to Hazard Areas							
ID	NAME	TYPE	Landslide	Within FEMA Flood Zone	Locally IDed Area of Flooding	Avg. Annual Snow Fall	Surge Areas: Cat.#
20	Beverly Hospital Child Dev. Center	Day Care	Low	No	No	High	0
21	Beverly High School	School	Low	No	No	High	0
22	Shore Country Day	School	Low	No	No	High	0
23	North Shore Nursery	Day Care	Low	No	Chubb Creek	High	0
24	Campbell Funeral Home	Mortuary	Low	No	No	High	0
25	Creation Station Pre-school	Day Care	Low	No	No	High	0
26	Cell Tower	Cell Tower	Low	No	No	High	0
27	North Beverly Rail Station	Train Stations	Low	No	No	High	0
28	St John The Evangelist	School	Low	No	No	High	0
29	Beverly Farms Cemetery	Cemetery	Low	No	Chubb Creek	High	0
30	North Beverly Elementary School	School	Low	No	No	High	0
31	North Shore Community Baptist Church Inc	Church	Low	No	No	High	0
32	Essex Park	Nursing Home	Low	No	No	High	0
33	Beverly Tank	Standpipe	Low	No	No	High	0
34	Beverly Hospital	Helipport	Low	No	No	High	0
35	Kindercare	School	Low	No	No	High	0
36	Ledgewood Rehabilitation And S	Nursing Home	Low	No	No	High	0
37	East Beverly No 51	Mass Electric	Low	No	No	High	0
38	Harborlight Montessori Dev.	Day Care	Low	No	No	High	0

**CITY OF BEVERLY HAZARD MITIGATION PLAN
2012 UPDATE**

Table 10: Relationship of Critical Infrastructure to Hazard Areas							
ID	NAME	TYPE	Landslide	Within FEMA Flood Zone	Locally IDed Area of Flooding	Avg. Annual Snow Fall	Surge Areas: Cat.#
	Ct						
39	Harborlight Montessori	School	Low	No	No	High	0
40	Balch St No 72	Mass Electric	Low	No	No	High	0
41	Mckeown Elementary School	School	Low	No	No	High	0
42	Sail Program	Children Residence	Low	No	No	High	0
43	Beverly Farms Branch Library	Library	Low	No	No	High	0
44	Beverly Farms Fire Station	Fire Station	Low	No	No	High	0
45	West Beach	Beaches	Low	VE	Chubb Creek	High	0
46	Beverly Historical Society-Balch House	Cultural resource	Low	No	North Beverly Brook	High	0
47	Children Aboard Rainbow Express	Day Care	Low	No	No	High	0
48	Beverly Farms	Train Stations	Low	No	Chubb Creek	High	0
49	Cape Ann Waldorf School	School	Low	No	No	High	0
50	Montserrat Rail Station	Train Stations	Low	No	No	High	0
51	Senior Center	Cultural resource	Low	No	No	High	0
52	Briscoe Middle School	School	Low	No	No	High	0
53	Prides Crossing Rail Station	Train Stations	Low	No	No	High	0

**CITY OF BEVERLY HAZARD MITIGATION PLAN
2012 UPDATE**

Table 10: Relationship of Critical Infrastructure to Hazard Areas							
ID	NAME	TYPE	Landslide	Within FEMA Flood Zone	Locally IDed Area of Flooding	Avg. Annual Snow Fall	Surge Areas: Cat.#
54	Prides Crossing Station	Post Office	Low	No	No	High	0
55	Anchorage Aftercare/Charles	Children Residence	Low	No	No	High	0
56	Brooks Pharmacy	Pharmacies	Low	No	No	High	0
57	Stoneridge Children's Monte	School	Low	No	No	High	0
58	Friendship Preschool	Day Care	Low	No	No	High	0
59	Beverly School For The Deaf	School	Low	No	No	High	0
60	Cove Elementary School	School	Low	No	No	High	0
61	Endicott College	College	Low	No	No	High	0
62	So. New Eng Conf. Ass-seventh Day Advent	Church	Low	No	No	High	0
63	YMCA-McKeown School	Day Care	Low	No	No	High	0
64	Landmark School	School	Low	No	No	High	0
65	CVS-Downtown	Pharmacies	Low	No	No	High	4
66	Landmark School Tot Spot	Day Care	Low	No	No	High	0
67	DPW Headquarters	DPW Barn	Low	No	No	High	4
68	Walgreen Drug Stores	Pharmacies	Low	No	No	High	0
69	Ayer's After School Program	Day Care	Low	No	No	High	0
70	North Shore Head Start	Day Care	Low	No	No	High	0
71	Beverly Housing Authority	Municipal Office	Low	No	No	High	0
72	Central Cemetery	Cemetery	Low	No	No	High	0
73	Immanuel Day School	Day Care	Low	No	No	High	0

**CITY OF BEVERLY HAZARD MITIGATION PLAN
2012 UPDATE**

Table 10: Relationship of Critical Infrastructure to Hazard Areas							
ID	NAME	TYPE	Landslide	Within FEMA Flood Zone	Locally IDed Area of Flooding	Avg. Annual Snow Fall	Surge Areas: Cat.#
74	Beverly Children's Learning Center	Day Care	Low	No	No	High	0
75	Gar Hall	Cultural resource	Low	No	No	High	0
76	Dane Street Church	Church	Low	No	No	High	0
77	Sewer Pumping Station	Sewer Pump Station	Low	No	No	High	0
78	Lee & Moody Funeral Home	Mortuary	Low	No	No	High	0
79	Beverly Public Library	Library	Low	No	No	High	0
80	Mingo Beach	Beaches	Low	VE	No	High	2
81	Montserrat College Of Art	College	Low	No	No	High	0
82	First Assembly Of God Church Of Beverly	Church	Low	No	No	High	0
83	Roman Catholic Church	Church	Low	No	No	High	0
84	St Mary Star Of The Sea	School	Low	No	No	High	0
85	Beverly Children's Learning Center	Day Care	Low	No	No	High	0
86	Cabot Street Children's Center	Day Care	Low	No	No	High	0
87	Beverly Historical Society	Cultural resource	Low	No	No	High	0
88	Beverly Train Station	Train Stations	Low	No	No	High	0
89	First Parish Unitarian Church	Church	Low	No	No	High	0

**CITY OF BEVERLY HAZARD MITIGATION PLAN
2012 UPDATE**

Table 10: Relationship of Critical Infrastructure to Hazard Areas							
ID	NAME	TYPE	Landslide	Within FEMA Flood Zone	Locally IDed Area of Flooding	Avg. Annual Snow Fall	Surge Areas: Cat.#
90	St Peters Church	Church	Low	No	No	High	0
91	First Baptist Church In Beverly	Church	Low	No	No	High	0
92	Lynch Park	Sea Walls	Low	AE	No	High	1
93	Beverly Fire Dept	Fire Station	Low	No	No	High	0
94	Christian Science Society	Church	Low	No	No	High	0
95	Dane Street Beach	Beaches	Low	VE	No	High	1
96	Obear Beach	Beaches	Low	AE	Eroded Bank at Obear Park	High	1
97	Goat Hill Beach	Beaches	No	AE	No	High	1
98	Boston Gas Co	Public Utilities	Low	AE	No	High	1
99	Rices Beach	Beaches	Low	AE	No	High	0
100	Main Post Office	Post Office	Low	No	No	High	0
101	Sewer Pump Station	Sewer Pump Station	Low	AE	No	High	1
102	Beverly No. 12 Substation	Hazmat	Low	AE	No	High	1
103	Mrs. Alexander's School	School	Low	No	No	High	0
104	Beverly Historical Society-cab	Cultural resource	Low	No	No	High	0
105	Homeward Bound	Children Residence	Low	No	No	High	0
106	Girder House (Retirement Home for Ladies	Assisted Living	Low	No	No	High	0
107	Independence Park Beach	Beaches	Low	VE	No	High	0
108	Cabot Street	Boat Ramp	Low	AE	Commercial docks at	High	1

**CITY OF BEVERLY HAZARD MITIGATION PLAN
2012 UPDATE**

Table 10: Relationship of Critical Infrastructure to Hazard Areas							
ID	NAME	TYPE	Landslide	Within FEMA Flood Zone	Locally IDed Area of Flooding	Avg. Annual Snow Fall	Surge Areas: Cat.#
					Beverly Harbor Center		
109	Cell Tower-128	Cell Tower	Low	No	No	High	0
110	Beverly Water Tower	Water Tower	Low	No	No	High	0
111	CVS-Beverly Plaza	Pharmacies	Low	No	No	High	0
112	Comcast	Hazmat	Low	No	North Beverly Brook	High	0
113	Essex County Newspapers	Hazmat	Low	No	No	High	0
114	Blueberry Hill Healthcare	Nursing Home	Low	No	No	High	0
115	Roller Palace	Skating Rink	Low	No	No	High	0
116	Roman Catholic Cemetery	Cemetery	Low	No	No	High	0
117	YMCA-Hannah School	Day Care	Low	No	No	High	0
118	Beverly Y Building Blocks	Day Care	Low	No	No	High	0
119	Memorial Middle School	School	Low	No	No	High	0
120	Sewer Pump St.	Sewer Pump Station	Low	0.2 PCT ANNUAL CHANCE FLOOD HAZARD	Chubb Creek	High	1
121	Bright Horizons @ Cummings Center	School	Low	AE	North Beverly Brook	High	2
122	Dock Lane	Boat Ramp	No	AE	No	High	0
123	Stop & Shop	Pharmacies	Low	No	No	High	1
124	Bass Haven Yacht Club	Marina	Low	0.2 PCT ANNUAL CHANCE FLOOD HAZARD	No	High	1
125	Ayers/Ryal Side Elementary School	School	Low	No	No	High	0

**CITY OF BEVERLY HAZARD MITIGATION PLAN
2012 UPDATE**

Table 10: Relationship of Critical Infrastructure to Hazard Areas							
ID	NAME	TYPE	Landslide	Within FEMA Flood Zone	Locally IDed Area of Flooding	Avg. Annual Snow Fall	Surge Areas: Cat.#
126	Beverly Port Marina	Marina	Low	AE	Water Street	High	3
127	Jubilee Yacht Club	Marina	Low	VE	No	High	2
128	Sewer Pump St. SESD	Sewer Pump Station	Low	VE	No	High	2
129	Stop & Shop	Supermarket	Low	No	No	High	0
130	Postal Distribution Center	Postal Distribution	Low	No	North Beverly Brook	High	0
131	Nexus House	Children Residence	Low	No	No	High	0
132	Stop & Shop	Supermarket	Low	No	No	High	1
133	First Federated Church of Beverly	Church	Low	No	No	High	0
134	St. Johns Parish	Church	Low	No	No	High	0
135	Roman Catholic Church	Church	Low	No	No	High	0
136	Beverly Hospital	Cell Tower	Low	No	No	High	0
137	Shaw's Supermarket	Supermarket	Low	No	No	High	0
138	Beverly Airport	Airport	Low	No	No	High	0
139	Essex Bridge	Bridge	Low	No	No	High	0
140	Brackenbury Lane	Boat Ramp	Low	VE	No	High	2
141	Water St	Boat Ramp	Low	VE	No	High	2
142	Bay View	Boat Ramp	Low	No	Bayview Seawall	High	0
143	Hall Witaker Bridge	Bridge	No	AE	No	High	0
144	Kernwood Bridge	Bridge	Low	No	No	High	4
145	City of Beverly Harbor Mgmt	Marina	Low	AE	Commercial docks at Beverly Harbor Center	High	2

**CITY OF BEVERLY HAZARD MITIGATION PLAN
2012 UPDATE**

Table 10: Relationship of Critical Infrastructure to Hazard Areas							
ID	NAME	TYPE	Landslide	Within FEMA Flood Zone	Locally IDed Area of Flooding	Avg. Annual Snow Fall	Surge Areas: Cat.#
146	Wenham Lake	Reservoir	Low	A	No	High	0
147	Woodbury Beach	Beaches	Low	AE	No	High	1
148	Lynch Park Beach	Beaches	Low	VE	No	High	0
149	Brackenbury Beach	Beaches	Low	VE	No	High	1
150	Norwood Pond	Pond	Low	A	No	High	0
151	Sandy Point Beach	Beaches	Low	VE	No	High	0
152	Beverly Hospital	Hazmat	Low	No	No	High	0
153	Harbourlight House	Assisted Living	Low	No	No	High	0
154	Landmark at Ocean View	Assisted Living	Low	No	No	High	0
155	Second Congregational Church of Beverly	Church	Low	No	No	High	0
156	Covenant Christian School	School	Low	No	No	High	0
157	Spectrum Adult Day Health Center	Adult Day Care	Low	No	North Beverly Brook	High	3
158	Elder Services Plan of Northshore	Adult Day Care	Low	AE	North Beverly Brook	High	2
159	Hillhouse	Children Residence	Low	No	No	High	0
160	Harborlight Montessori School. Inc	School	Low	No	No	High	0
161	Rain or Shine Day Care	Day Care	Low	No	No	High	0
162	YMCA Nursery School	School	Low	No	No	High	0
163	YMCA-Cove School	Day Care	Low	No	No	High	0

**CITY OF BEVERLY HAZARD MITIGATION PLAN
2012 UPDATE**

Table 10: Relationship of Critical Infrastructure to Hazard Areas							
ID	NAME	TYPE	Landslide	Within FEMA Flood Zone	Locally IDed Area of Flooding	Avg. Annual Snow Fall	Surge Areas: Cat.#
164	YMCA-McKeown School	Day Care	Low	No	No	High	0
165	YMCA-North Beverly School	Day Care	Low	No	No	High	0
166	Shoe Pond Dam at end of Sturtevant St	Dam	Low	AE	No	High	2
167	Shoe Pond Dam	Dam	Low	AE	North Beverly Brook	High	2

CITY OF BEVERLY HAZARD MITIGATION PLAN 2011 UPDATE

Vulnerability Assessment

The purpose of the vulnerability assessment is to estimate the extent of potential damages from natural hazards of varying types and intensities. A vulnerability assessment and estimation of damages was performed for hurricanes, earthquakes, and flooding. The methodology used for hurricanes and earthquakes was the HAZUS-MH software. The methodology for flooding was developed specifically to address the issue in many of the communities where flooding was not solely related to location within a floodplain.

Introduction to HAZUS-MH

HAZUS- MH (multiple-hazards) is a computer program developed by FEMA to estimate losses due to a variety of natural hazards. The following overview of HAZUS-MH is taken from the FEMA website. For more information on the HAZUS-MH software, go to <http://www.fema.gov/plan/prevent/hazus/index.shtm>

“HAZUS-MH is a nationally applicable standardized methodology and software program that contains models for estimating potential losses from earthquakes, floods, and hurricane winds. HAZUS-MH was developed by the Federal Emergency Management Agency (FEMA) under contract with the National Institute of Building Sciences (NIBS). Loss estimates produced by HAZUS-MH are based on current scientific and engineering knowledge of the effects of hurricane winds, floods and earthquakes. Estimating losses is essential to decision-making at all levels of government, providing a basis for developing and evaluating mitigation plans and policies as well as emergency preparedness, response and recovery planning.

HAZUS-MH uses state-of-the-art geographic information system (GIS) software to map and display hazard data and the results of damage and economic loss estimates for buildings and infrastructure. It also allows users to estimate the impacts of hurricane winds, floods and earthquakes on populations.”

There are three modules included with the HAZUS-MH software: hurricane wind, flooding, and earthquakes. There are also three levels at which HAZUS-MH can be run. Level 1 uses national baseline data and is the quickest way to begin the risk assessment process. The analysis that follows was completed using Level 1 data.

Level 1 relies upon default data on building types, utilities, transportation, etc. from national databases as well as census data. While the databases include a wealth of information on the nine communities that are a part of this study, it does not capture all relevant information. In fact, the HAZUS training manual notes that the default data is “subject to a great deal of uncertainty.”

However, for the purposes of this plan, the analysis is useful. This plan is attempting to only generally indicate the possible extent of damages due to certain types of natural disasters and to allow for a comparison between different types of disasters. Therefore,

CITY OF BEVERLY HAZARD MITIGATION PLAN 2011 UPDATE

this analysis should be considered to be a starting point for understanding potential damages from the hazards. If interested, communities can build a more accurate database and further test disaster scenarios.

Estimated Damages from Hurricanes

According to the State Hazard Mitigation Plan, between 1858 and 2000, there were 15 hurricanes. 60% were Category 1, 33% were Category 2 and 7% were Category 3. For the purposes of this plan, Category 2 and a Category 4 storms were chosen to illustrate damages. The Category 4 storm was included in order to present a reasonable “worst case scenario” that would help planners and emergency personnel evaluate the impacts of storms that might be more likely in the future, as we enter into a period of more intense and frequent storms.

Table 11
Estimated Damages from Hurricanes

	Category 2	Category 4¹
Building Characteristics		
Estimated total number of buildings	11,054	11,054
Estimated total building replacement value (Year 2002 \$) (Millions of Dollars)	\$3,478	\$3,478
Building Damages		
# of buildings sustaining minor damage	355	1,121
# of buildings sustaining moderate damage	39	170
# of buildings sustaining severe damage	1	6
# of buildings destroyed	0	1
Population Needs		
# of households displaced	13	63
# of people seeking public shelter	3	14
Debris		
Building debris generated (tons)	5,192	11,283
Tree debris generated (tons)	3,219	5,980
# of truckloads to clear building debris	79	213
Value of Damages (Thousands of dollars)		
Total property damage	\$12,555	\$33,331.79
Total losses due to business interruption	\$1,052.06	\$4,024.29
¹ No Category 4 or 5 hurricanes have been recorded in New England. However, a Category 4 hurricane was included to help the communities understand the impacts of a hurricane beyond what has historically occurred in New England.		

CITY OF BEVERLY HAZARD MITIGATION PLAN 2011 UPDATE

Estimated Damages from Earthquakes

Methodology Used

In order to assess damages from earthquakes, the HAZUS-MH earthquake module was used. For more information, see the description of the HAZUS-MH software above. The HAZUS earthquake module allows users to define a number of different types of earthquakes and to input a number of different parameters. The module is more useful where there is a great deal of data available on earthquakes. In New England, defining the parameters of a potential earthquake is much more difficult because there is little historical data. The earthquake module does offer the user the opportunity to select a number of historical earthquakes that occurred in Massachusetts. For the purposes of this plan, two earthquakes were selected: a 1963 earthquake with a magnitude of 5.0 and an earthquake with a magnitude of 7.0.

Table 12
Estimated Damages from Earthquakes

	Magnitude 5.0	Magnitude 7.0
Building Characteristics		
Estimated total number of buildings	11,054	11,054
Estimated total building replacement value (Year 2002 \$) (Millions of dollars)	\$3,478	\$3,478
Building Damages		
# of buildings sustaining slight damage	415	3,691
# of buildings sustaining moderate damage	82	3,319
# of buildings sustaining extensive damage	10	1,153
# of buildings completely damaged	1	391
Population Needs		
# of households displaced	16	1,811
# of people seeking public shelter	3	406
Debris		
Building debris generated (tons)	Not available	Not available
Value of Damages (Millions of dollars)		
Total property damage	\$55.95	\$961.05
Total losses due to business interruption	\$2.80	\$170.80

CITY OF BEVERLY HAZARD MITIGATION PLAN 2011 UPDATE

Estimated Damages from Flooding

Methodology Used

MAPC did not use HAZUS-MH to estimate flood damages in Beverly. In addition to technical difficulties with the software, the riverine module is not a reliable indicator of flooding in areas where inadequate drainage systems contribute to flooding even when those structures are not within a mapped flood zone. In lieu of using HAZUS, MAPC developed a methodology to give a rough approximation of flood damages.

Beverly is 15.42 square miles or 9868.8 acres. Approximately 479.76 acres have been identified by local officials as areas of flooding. This amounts to 4.86 % of the land area in Beverly. The number of structures in each flood area was estimated by applying the percentage of the total land area to the number of structures (11,054) in Beverly; the same number of structures used by HAZUS for the hurricane and earthquake calculations. HAZUS uses a value of \$314,637 per structure for the building replacement value. This was used to calculate the total building replacement value in each of the flood areas. The calculations were done for a low estimate of 10% building damages and a high estimate of 50% as suggested in the FEMA September 2002 publication, "State and Local Mitigation Planning how-to guides" (Page 4-13). The range of estimates for flood damages is \$16,927,470- \$84,637,350. These calculations are not based solely on location within the floodplain or a particular type of storm (i.e. 100 year flood).

**CITY OF BEVERLY HAZARD MITIGATION PLAN
2011 UPDATE**

**Table 13
Estimated Damages from Flooding**

ID	Flood Hazard Area	Approximate Area in Acres	% of Total Land Area in Beverly	# of Structures	Replacement Value	Low Estimate of Damages	High Estimate of Damages
1	North Bevely Brook	214.82	2.178	241	\$75,827,517	\$7,582,752	\$37,913,760
2	Lawrence Street Brook	22.44	0.227	25	\$7,865,925	\$786,592	\$3,932,962
3	Chubb Creek	151.05	1.531	169	\$53,173,653	\$5,317,653	\$26,586,827
4	Norwood Pond	7.91	0.080	9	\$2,831,733	\$283,173	\$1,415,866
5	Longham Reservoir Dam	12.67	0.128	14	\$4,404,918	\$440,492	\$2,202,459
6	Water Street	32.13	0.326	36	\$11,326,932	\$1,132,693	\$5,663,466
7	Milbrook Road	7.86	0.080	9	\$2,831,733	\$283,173	\$1,415,866
12	Bayview Seawall	3.43	0.035	4	\$1,258,548	\$125,855	\$629,274
13	Commercial Docks at Beverly HarborCenter	2.03	0.021	2	\$629,274	\$62,927	\$314,637
14	Tide Gate at Head of Bass R.	1.50	0.015	2	\$629,274	\$62,927	\$314,637
15	Eroded Bank at Obear Park	22.51	0.228	25	\$7,865,925	\$786,593	\$3,932,962
16	Tide Gate at Bass River	1.42	0.014	2	\$629,274	\$62,927	\$314,637
Total		479.76	4.86	538	\$169,274,706	\$16,927,470	\$84,637,350

**CITY OF BEVERLY HAZARD MITIGATION PLAN
2011 UPDATE**

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CITY OF BEVERLY HAZARD MITIGATION PLAN 2011 UPDATE

V. HAZARD MITIGATION GOALS

The Beverly Local Multiple Hazard Community Planning Team met on August 18, 2010. At that meeting, the team reviewed and discussed the goals from the 2005 Hazard Mitigation Plan for the City of Beverly. Reflective of City staff's increasing knowledge and familiarity with hazard mitigation planning and the potential impacts of natural hazard events on Beverly, the local committee modified Goal 6 to emphasize the regional nature of coastal erosion issues and added Goal 10.

The following ten goals were endorsed by the Committee for the 2010 update of the Beverly Hazard Mitigation Plan:

1. Ensure that critical infrastructure sites are protected from natural hazards.
2. Protect existing residential and business areas from flooding.
3. Maintain existing mitigation infrastructure in good condition.
4. Continue to enforce existing zoning and building regulations.
5. Educate the public about zoning and building regulations, particularly with regard to changes in regulations that may affect tear-downs and new construction.
6. Work with surrounding communities to ensure regional cooperation and solutions for hazards affecting multiple communities such as coastal erosion.
7. Encourage future development in areas that are not prone to natural hazards.
8. Educate the public about natural hazards and mitigation measures.
9. Make efficient use of public funds for hazard mitigation.
10. Protect the City's ability to respond to various natural hazard events.

**CITY OF BEVERLY HAZARD MITIGATION PLAN
2011 UPDATE**

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CITY OF BEVERLY HAZARD MITIGATION PLAN 2011 UPDATE

VI. EXISTING MITIGATION MEASURES

Existing Multi-Hazard Mitigation Measures

Comprehensive Emergency Management Plan (CEMP) – Every community in Massachusetts is required to have a Comprehensive Emergency Management Plan. These plans address mitigation, preparedness, response and recovery from a variety of natural and man-made emergencies. These plans contain important information regarding flooding, hurricanes, tornadoes, dam failures, earthquakes, and winter storms. Therefore, the CEMP is a mitigation measure that is relevant to all of the hazards discussed in this plan.

Communications Equipment – The City utilizes the Incident Command Unit, a mobile communications center available to the City through the MA State Police and The MA Department of Fire Services. The City has a Reverse 911 system in place.

Emergency Power Generators – Emergency power generators can be found in all but one of the City's fire stations, the DPW facility, the Hannah School and the High School.

Massachusetts State Building Code – The Massachusetts State Building Code contains many detailed regulations regarding wind loads, earthquake resistant design, flood-proofing, and snow loads.

Southern Essex Regional Emergency Management Planning Committee (REPC) – Beverly is a member of a regional emergency planning committee together with Danvers, Essex, Gloucester, Lynn, Manchester-by-the-Sea, Marblehead, Nahant, Peabody, Rockport, Salem, Swampscott

Public Information & Outreach – The City provides information to residents and business owners relating to a range of potential natural hazards, most especially with regard to flooding, hurricanes, and northeasters.

Existing Flood Hazard Mitigation Measures

National Flood Insurance Program (NFIP) – Beverly participates in the NFIP with 258 policies in force as of the May 31, 2010. FEMA maintains a database on flood insurance policies and claims. This database can be found on the FEMA website at <http://www.fema.gov/business/nfip/statistics/pcstat.shtm>

The City complies with the NFIP by enforcing floodplain regulations, maintaining up-to-date floodplain maps, and providing information to property owners and builders regarding floodplains and building requirements.

The following NFIP information is provided for the City of Beverly:

**CITY OF BEVERLY HAZARD MITIGATION PLAN
2011 UPDATE**

Flood insurance policies in force (as of July 31, 2010)	258
Coverage amount of flood insurance policies	\$ 59,655,100
Premiums paid	\$ 209,527
Total losses (all losses submitted regardless of the status)	130
Closed losses (Losses that have been paid)	89
Open losses (Losses that have not been paid in full)	0
CWOP losses (Losses that have been closed without payment)	41
Total payments (Total amount paid on losses)	\$636,540.90

Since the 2005 plan, the policies in force have increased by 66 and the total losses have increased by 23. The total payments, as of December 21, 2004, were \$408,923.66, \$226,617 less than the most recent figure.

Public Works Operations/Maintenance Activities – The Public Works Department actively maintains the City’s storm drain system. The following specific activities serve to maintain the capability of the drainage system through the reduction of sediment and litter build up and proper maintenance and repair.

- *Street sweeping* – Street sweeping is conducted three times annually, with downtown area streets swept twice weekly.
- *Catch basin cleaning* –3500 catch basins cleaned annually (some biannually as needed).
- *Roadway treatments* – Calcium Chloride is used for snow/ice treatment.
- *Drainage maintenance*- Approximately 85% of the City’s catch basins and drain lines are now digitally mapped.
- *Historical drainage*-Beverly is able to map connectivity between streams, topography and its drainage system by scanning historic aerial photos, starting from the 1940s, into its GIS system.

2002 City of Beverly Master Plan – Given Beverly’s coastal location, natural hazard mitigation ideas and strategies are referenced in the plan. These references include investigation to see if current wetland protection rules and regulations are adequate to preserve their critical roles in providing habitat, storm buffering and floodwater storage. The Master Plan also calls for the coordination of open space policies to protect open space, minimize development impacts, allow development of residential areas, protect and improve natural resources, and establish greenways and riparian corridors. Specifically, the Plan calls for the adoption of Open Space Residential Design subdivisions to preserve open space, promote the infiltration of stormwater, reducing runoff, erosion and flooding.

CITY OF BEVERLY HAZARD MITIGATION PLAN 2011 UPDATE

2008 Open Space and Recreation Plan- One of the Plan's top priorities is the acquisition of lands with high "natural and environmental values" particularly within the Wenham Lake and Longham Reservoir watersheds and the City's Water Protection Overlay District. The plan is up to date and certified by the MA Department of Conservation and Recreation.

Floodplain Overlay District – Zoning is intended to protect the public health and safety through the regulation of land use. The Beverly Zoning Ordinance includes a Floodplain District (Sections 29-31). The purposes of this district are:

- A. To protect the health and safety of residents of lands subject to seasonal or periodic flooding;
- B. To minimize future flood damage by providing for the maintenance of existing waterways, water bodies, and wetlands through a Flood Plain management program.

The Floodplain Overlay District is an overlay district, defined by the 100-year floodplain as designated by FEMA. Within the District, the following requirements must be met:

- Any uses permitted shall be subject to the provisions of the Commonwealth State Building Code, section 744, entitled "Design Requirements for Floodplains and Coastal High Hazard Areas."
- All encroachments, including fill, new construction, substantial improvements to existing structures, and other developments are prohibited in the floodway as designated on the Flood Boundary and Floodway Map for Beverly
- In zone AO, (areas of 100-year shallow flooding where depths are between one and three feet), for all new construction and substantial improvements, it is required that:
 - 1. Residential structures have the lowest floor (including basement) elevated above the crown of the nearest street to or above the depth specified on Beverly's Flood Insurance Rate Maps (FIRMS).
 - 2. Non-residential structures have the lowest floor (including basement) elevated above the crown of the nearest street to or above the depth specified on Beverly's FIRM or be flood proofed to or above that level.
- In zones VI - V30, (areas of 100-year coastal flood with wave action), all new construction or substantial improvements must be located landward of the reach of mean high tide.

Flood Plain Management Plan – In 1970, the City commissioned Camp Dresser and McKee to do a study to identify all critical drainage problems and outline a number of capital projects that, if undertaken, would address most of the neighborhood-wide flooding. No action was taken until 1998 when the City authorized \$10 million in bonds to undertake three of the projects. Two of the projects have been completed, as well as the first phase of work at Chubb's Brook.

Subdivision Rules and Regulations - The Beverly Subdivision Rules and Regulations contains provisions intended to reduce the impacts of floods and erosion. Through its design and layout standards, the bylaws contribute to the City's overall efforts to mitigate

CITY OF BEVERLY HAZARD MITIGATION PLAN 2011 UPDATE

the risks for damage through flooding. Some of the contributing provisions include the following:

- Open Space Residential Design (OSRD) required for all subdivisions of four lots or greater in some residential districts and three lots or greater in low density residential districts. OSRD encourages the protection and permanent preservation of open space, forestry land, wildlife habitat, other natural resources including public water supplies, aquifers, water bodies and wetlands, and historical resources in a manner that is consistent with Beverly's Master Plan and Open Space and Recreation Action Plan (together, the "Master Plans");
- OSRD subdivisions are encouraged to use non-structural stormwater management techniques such as rain gardens and bio-retention swales and others that do not create impervious surfaces and enable stormwater infiltration.
- At least 50% of the OSRD tract must remain undisturbed land.

Wetlands Protection By-Law – The purpose of the Wetlands Protection Regulations is to further protect the City's shores, ponds, rivers, and wetlands for, among other reasons, flood control, erosion and sedimentation control, and public safety. The by-law builds on the State Wetlands Protection Act offering more stringent controls over vernal ponds and isolated vegetated wetlands. There is a 100-foot no-disturb zone for any vernal pond and a 25-foot no-disturb zone for any isolated or bordering vegetated wetland. Any activity that might fill or otherwise alter these resource areas requires a permit from the Beverly Conservation Commission.

Stormwater Management and Construction Site Management Ordinance – Any development or redevelopment that alters more than one acre of land must comply with the City's stormwater management ordinance, whose standards match the MA Stormwater Management Standards, including no increase in post-development peak runoff rates compared to pre-development rates. The ordinance also prohibits illegal stormwater connections, and implements development standards for erosion control and land contour changes.

Mosquito Control Ditch Maintenance – City representatives noted that the mosquito control district had a program of ditch cleaning that helped keep drainage ditches clear of debris. With the advent of West Nile virus, the mosquito control district has shifted funding from maintenance to monitoring. The result is that drainage ditches are not as well maintained.

DCR dam safety regulations – The state has enacted dam safety regulations mandating inspections and emergency action plans. All new dams are subject to state permitting.

Seawalls, Jetties and Dikes- There are four miles of coastline in Beverly with a significant number of seawalls. Most of the seawalls are privately owned. Though included in past Capital Improvement Programs, the City has not undertaken a comprehensive study of the condition of all its seawalls.

CITY OF BEVERLY HAZARD MITIGATION PLAN 2011 UPDATE

Existing Wind Hazard Mitigation Measures

CEMP – The Beverly Comprehensive Emergency Management Plan contains a section on hurricanes. It lists five generic mitigation measures:

- Develop and disseminate emergency public information and instructions concerning hurricane preparedness and safety.
- Community leaders should ensure that Beverly is enrolled in the National Flood Insurance Program.
- Develop and enforce local building codes to enhance structural resistance to high winds and flooding. Build new construction in areas that are not vulnerable to direct hurricane effects.
- Make informed decisions concerning protecting natural attributes such as beaches and dunes with breakwaters and sea walls. Review National Flood Insurance Rate Maps and Hurricane Evacuation Maps for possible impact on the community.
- Maintain plans for managing all hurricane emergency response activities.

The Beverly CEMP outlines three generic mitigation measures for tornadoes.

- Develop and disseminate emergency public information and instructions concerning tornado safety, especially guidance regarding in-home protection and evacuation procedures, and locations of public shelters.
- Strict adherence should be paid to building code regulations for all new construction.
- Maintain plans for managing tornado response activities. Refer to the non-institutionalized, special needs and transportation resources listed in the Resource Manual.

Massachusetts State Building Code – The City enforces the Massachusetts State Building Code whose provisions are generally adequate to protect against most wind damage. The code's provisions are the most cost-effective mitigation measure against tornados given the extremely low probability of occurrence. If a tornado were to occur, the potential for severe damages would be extremely high.

Tree-trimming program – The City conducts its own tree maintenance and also uses its own equipment to trim and remove trees as needed and grind stumps. National Grid also maintains its utility line corridors on a rotating, 3-year cycle.

Existing Winter Hazard Mitigation Measures

Snow disposal – Regular plowing and snow/ice removal. Calcium chloride is used primarily for road treatments. Sand is very rarely used as it creates siltation and clean up problems.

CITY OF BEVERLY HAZARD MITIGATION PLAN 2011 UPDATE

Existing Brush Fire Hazard Mitigation Measures

Burn Permits – The City fire department requires a written permit for outdoor burning, which includes explanation of the related regulations and precautions for the permit-holder to take. The permit-holder must call the fire department on the proposed burn day to confirm weather conditions are suitable for outdoor burning.

Subdivision/Development Review – The Fire Department participates in the review of new subdivisions and development projects.

Existing Geologic Hazard Mitigation Measures

Massachusetts State Building Code – The State Building Code contains a section on designing for earthquake loads (780 CMR 1612.0). Section 1612.1 states that the purpose of these provisions is “to minimize the hazard to life to occupants of all buildings and non-building structures, to increase the expected performance of higher occupancy structures as compared to ordinary structures, and to improve the capability of essential facilities to function during and after an earthquake”. This section goes on to state that due to the complexity of seismic design, the criteria presented are the minimum considered to be “prudent and economically justified” for the protection of life safety. The code also states that absolute safety and prevention of damage, even in an earthquake event with a reasonable probability of occurrence, cannot be achieved economically for most buildings.

Section 1612.2.5 sets up seismic hazard exposure groups and assigns all buildings to one of these groups according to a Table 1612.2.5. Group II includes buildings which have a substantial public hazard due to occupancy or use and Group III are those buildings having essential facilities which are required for post-earthquake recovery, including fire, rescue and police stations, emergency rooms, power-generating facilities, and communications facilities.

**CITY OF BEVERLY HAZARD MITIGATION PLAN
2011 UPDATE**

Table 14- Beverly Existing Mitigation Measures

Type of Existing Mitigation Measures	Area Covered	Effectiveness/ Enforcement	Improvements/ Changes Needed
MULTIPLE HAZARDS			
Comprehensive Emergency Management Plan (CEMP)	City-wide.	Emphasis is on emergency response.	None.
Communications Equipment	City-wide.	Effective	Increase number of Fire Department hand held radios, master boxes and fire alarms.
Massachusetts State Building Code	City-wide.	Effective for new construction.	None.
Emergency Power Generators	City-wide.	Effective.	Upgrade generators as needed; provide generators at additional locations; provide alternative fuel sources and generator power source flexibility.
Participation in the Southern Essex Regional Emergency Planning Committee (REPC)	City-wide.	A forum for cooperation on natural and manmade disasters.	None.
FLOOD HAZARDS			
Participation in the National Flood Insurance Program (NFIP)	Areas identified on the FIRM maps.	There are 258 policies in force.	Encourage all eligible homeowners to obtain insurance.
Public Works Operations/Maintenance	City-wide.	Effective.	
Master Plan	City-wide		Include a new section on Climate Change in the next update.
Open Space Plan	City-wide		Target acquisition of open space parcels with flood storage capacity.
Zoning – Floodplain District	City-wide.	Effective for new construction.	Working with FEMA to update Floodplain District, including language and Community Rating System updates.

**CITY OF BEVERLY HAZARD MITIGATION PLAN
2011 UPDATE**

Type of Existing Mitigation Measures	Area Covered	Effectiveness/ Enforcement	Improvements/ Changes Needed
Subdivision Rules and Regulations	City-wide		
Wetlands Protection Ordinance	Resource Areas	Effective.	None.
Open Space Residential Design Subdivisions	New subdivisions >4 lots	Effective.	None.
Stormwater Management Ordinance	City-wide	Effective.	None.
DCR Dam Safety Regulations	Dams	Effective.	None.
Mosquito Control Ditch Maintenance	City-wide.	Somewhat effective.	Ditches need more maintenance.
Seawalls, Jetties, and Dikes	Coastline	Not as effective.	Major improvements needed towards repair and maintenance. Additional funding required.
WIND HAZARDS			
CEMP	City-wide	Effective.	None.
The Massachusetts State Building Code	City-wide.	Effective for most situations except severe storms.	None.
Tree trimming program	City-wide.	Satisfactory.	
WINTER HAZARDS			
Snow Removal	City-wide.	Effective.	None.
BRUSH FIRE HAZARDS			
Burn Permit	City-wide.	Effective.	None.
Development Review	City-wide.	Effective.	None.
Public Education	City-wide	Effective.	None.
GEOLOGIC HAZARDS			
The Massachusetts State Building Code	City-wide.	Effective.	None.

**CITY OF BEVERLY HAZARD MITIGATION PLAN
2011 UPDATE**

VII. MITIGATION MEASURES FROM THE 2005 PLAN

Review and Update Process

At a meeting of the Beverly Hazard Mitigation Committee, City staff reviewed the potential mitigation measures identified in the 2005 North Shore Regional Pre-Disaster Mitigation Plan Beverly Annex and determined whether each measure had been implemented or deferred. Of those measures that had been deferred, the committee evaluated whether the measure should be deleted or carried forward into the 2010 Beverly Hazard Mitigation Plan. The decision on whether to delete or retain a particular measure was based on the committee's assessment of the continued relevance or effectiveness of the measure and whether the deferral of action on the measure was due to the inability of the City to take action on the measure.

**Table 15
Potential Mitigation Measures from the 2005 Plan**

Mitigation Measures	Priority	Implementation Responsibility	2011 Status
Tozier Road/North Beverly Brook Drainage Line	High	DPW	Implemented
Raymond Farms drain replacement	High	DPW	Implemented
Kelleher Pond	High	DPW	Implemented
Gate exercise program	High	DPW	Implemented
Repair Bass River Seawall	Medium	DPW	Implemented
Sea wall comprehensive study	Medium	DPW	Not Implemented
Educate property owners in high risk areas about the value of setbacks from the edge of a structure to the edge of brush	Medium	Fire Dept.	On-going
Study of the seismic vulnerability and upgrade needs for critical infrastructure sites	Medium	DPW	Not implemented
Investigate causes of mold problem in schools	Low	DPW, School Dept.	Implemented

**CITY OF BEVERLY HAZARD MITIGATION PLAN
2011 UPDATE**

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CITY OF BEVERLY HAZARD MITIGATION PLAN 2011 UPDATE

VIII. HAZARD MITIGATION STRATEGY

What is Hazard Mitigation?

Hazard mitigation means to permanently reduce or alleviate the losses of life, injuries and property resulting from natural and human-made hazards through long-term strategies. These long-term strategies include planning, policy changes, programs, projects and other activities. FEMA currently has three mitigation grant programs: the Hazards Mitigation Grant Program (HGMP), the Pre-Disaster Mitigation program (PDM), and the Flood Mitigation Assistance (FMA) program. The three links below provide additional information on these programs.

<http://www.fema.gov/government/grant/hmgrp/index.shtm>

<http://www.fema.gov/government/grant/pdm/index.shtm>

<http://www.fema.gov/government/grant/fma/index.shtm>

Hazard Mitigation Measures can generally be sorted into the following groups:

- **Prevention:** Government administrative or regulatory actions or processes that influence the way land and buildings are developed and built. These actions also include public activities to reduce hazard losses. Examples include planning and zoning, building codes, capital improvement programs, open space preservation, and stormwater management regulations.
- **Property Protection:** Actions that involve the modification of existing buildings or infrastructure to protect them from a hazard or removal from the hazard area. Examples include acquisition, elevation, relocation, structural retrofits, flood proofing, storm shutters, and shatter resistant glass.
- **Public Education & Awareness:** Actions to inform and educate citizens, elected officials, and property owners about the potential risks from hazards and potential ways to mitigate them. Such actions include outreach projects, real estate disclosure, hazard information centers, and school-age and adult education programs.
- **Natural Resource Protection:** Actions that, in addition to minimizing hazard losses also preserve or restore the functions of natural systems. These actions include sediment and erosion control, stream corridor restoration, watershed management, forest and vegetation management, and wetland restoration and preservation.

CITY OF BEVERLY HAZARD MITIGATION PLAN 2011 UPDATE

- **Structural Projects:** Actions that involve the construction of structures to reduce the impact of a hazard. Such structures include storm water controls (e.g., culverts), floodwalls, seawalls, retaining walls, and safe rooms.
- **Emergency Services Protection:** Actions that will protect emergency services before, during, and immediately after an occurrence. Examples of these actions include protection of warning system capability, protection of critical facilities, protection of emergency response infrastructure.
(Source: *FEMA Local Multi-Hazard Mitigation Planning Guidance*)

Regional and Inter-Community Considerations

Some hazard mitigation issues are strictly local. The problem originates primarily within the municipality and can be solved at the municipal level. Other issues are inter-community issues that involve cooperation between two or more municipalities in a local area. There is a third level of mitigation which is regional; involving a state, regional, or federal agency or an issue that involves numerous municipalities across a wide area of the metropolitan region.

Regional Partners

In many communities, mitigating natural hazards, particularly flooding, is more than a local issue. The drainage systems that serve these communities are a complex system of storm drains, roadway drainage structures, pump stations and other facilities owned and operated by a wide array of agencies including but not limited to the City of Beverly, the Department of Conservation and Recreation (DCR), and Massachusetts Department of Transportation (MDOT). The planning, construction, operations, and maintenance of these structures are integral to the flood hazard mitigation efforts of communities. These agencies must be considered the communities regional partners in hazard mitigation. These agencies also operate under the same constraints as communities do, including budgetary and staffing constraints and numerous competing priorities. In the sections that follow, the plan includes recommendations for activities where cooperation with these other agencies may be necessary. Implementation of these recommendations will require that all parties work together to develop solutions.

Inter-Community Considerations

Shoreline Environment – The coastal shoreline of the North Shore area is a dynamic environment where forces of erosion and deposition of sand are constantly at work changing the beach profile. This process disregards municipal boundaries as sand and other materials are moved along the coast. Shoreline protection measures such as sea walls, jetties, and others have an impact on this process with the potential of building up sand in some areas while stripping it away from others. Municipalities along the North Shore should work to understand how these processes are at work locally and consider mutually beneficial means of protecting their shore side communities from the impacts of storm damage and sea-level rise.

CITY OF BEVERLY HAZARD MITIGATION PLAN 2011 UPDATE

Process for Setting Priorities for Mitigation Measures

The decisions on priorities were made at a meeting of the local committee. Priority setting was based on local knowledge of the hazard areas, including impacts of hazard events and the extent of the area impacted and the relation of a given mitigation measure to the City's identified goals. In addition, MAPC asked the local committee to take into consideration factors such as the number of homes and businesses affected, whether or not road closures occurred and what impact closures had on delivery of emergency services and the local economy, anticipated project costs, whether the City currently had the technical and administrative capability to carry out the mitigation measures, whether any environmental constraints existed, and whether the City would be able to justify the costs relative to the anticipated benefits.

The listing of high, medium, and low priority mitigation measures is provided in the sections below and summarized in Table 16. Project order does not indicate priority unless noted.

High Priority Mitigation Measures

Flooding, Drainage Infrastructure, Sea Walls, and Dams

- A) Chubb Brook: Since 2004, the City has constructed two detention ponds and installed a berm at Dix Park to capture stormwater. Continuing work on Chubb Brook is the City's top priority project. It plans to increase stormwater storage capacity within the Chubb Brook watershed by upgrading the Dix Park berms, increasing the size of the Greenwood Detention Pond, constructing a new detention pond off Hart Street and cleaning and relining the storm drain lines along Goodwin Avenue.
- B) Install a tide gate at the mouth of the Bass River. The Bass River is subject to coastal storm surges and there are a number of commercial properties, including the Cummings Center at the head of the Bass River, that are affected by these storm driven coastal flooding events.
- C) Purchase a new excavator and brush grapple. The PDM Team identified the need to clear brush and fallen tree limbs from streets and power quickly following high wind events as a top priority.
- D) Identify resources to maintain City drainage infrastructure on an ongoing basis. Beverly would like to establish an ongoing and consistent program to inspect, repair and replace its drainage infrastructure.

CITY OF BEVERLY HAZARD MITIGATION PLAN 2011 UPDATE

Measures to Ensure Compliance with NFIP

- E) Floodplain District Management: Continue to enforce the Floodplain Zoning District and associated building regulations for floodplain areas. Update this district to remain consistent with FEMA guidelines and floodplain mapping. The City is currently reviewing its Floodplain regulations.
- F) Floodplain Mapping: Maintain up to date maps of local FEMA identified floodplains. The City anticipates updated National Flood Insurance Rate maps in 2011.
- G) Acquisition of Vacant Flood Prone Lands: Acquire priority open space parcels in floodplain areas in order to maintain flood storage and water infiltration capacity. These parcels may also be used for general conservation and recreation purposes.

Multi-hazard

- H) Emergency Power Generators: Upgrade all emergency power generators in emergency shelters and critical facilities as needed; provide alternative fuel sources and generator power source flexibility.
- I) Acquire a new, towable, multi-phase, diesel generator for sewer pump station emergency backup power and for multi-hazard emergency power needs.

Medium Priority Mitigation Measures

Flooding, Drainage Infrastructure, Sea Walls, and Dams

- J) Install a tide gate/flapper valve on existing drain on the Bass River near the 103 Elliot Street commercial condominiums. This is another area subject to coastal storm surge flooding issues.
- K) Replace approximately 6000- 8000 square feet of bottom-anchored floats at Beverly Harbor Center with concrete, pile-held floats.
- L) Repair the Bay View seawall.
- M) Repair the eroded western coastal bank at Obear Park.
- N) Master Plan Update: Include a section on Climate Change and its potential impacts on Beverly in the next update of the Cityscape Plan.
- O) Purchase twelve, 2-inch submersible pumps for basement pumpouts and other flood-related response efforts.

CITY OF BEVERLY HAZARD MITIGATION PLAN 2011 UPDATE

Brush Fires

- P) Purchase .5 miles of new 1.5-inch forestry hose; new 4x4, 350 gallon, 2-ton woods fire truck; new hand held fire pumps.

Earthquakes

- Q) Public Building Assessments: Assess the earthquake vulnerability of all public buildings. Investigate options to make all public buildings earthquake-resistant.

Lower Priority Mitigation Measures

Multi-hazard

- R) Purchase 50 new handheld radios for Fire Department.
- S) Replace current master fire alarm boxes with radio master box alarms.

CITY OF BEVERLY HAZARD MITIGATION PLAN 2011 UPDATE

Introduction to Mitigation Measures Table

Priority – The designation of high, medium, or low priority was done at the meeting of the Local Multiple Hazard Community Planning Team meeting. The designations reflect discussion and a general consensus developed at the meeting but could change as conditions in the community change. In determining project priorities, the local team considered potential benefits and project costs.

Hazard Area – Each mitigation measure is intended to address one or more of the natural hazard potentially impacting Beverly, such as Flooding, Wind, Fire, and Earthquake. Where the proposed measure is intended to address a specific locally identified area of concern, this area is identified as well.

Description of the Mitigation Measure – The description of each mitigation measure is brief and cost information is given only if cost data were already available from the community. The cost data represent a point in time and would need to be adjusted for inflation and for any changes or refinements in the design of a particular mitigation measure.

Measure Type – There are six different types of pre-disaster mitigation measures identified by FEMA for which a community may apply for Hazard Mitigation funding.

Implementation Responsibility – The designation of implementation responsibility was done by MAPC based on a general knowledge of what each municipal department is responsible for. It is likely that most mitigation measures will require that several departments work together and assigning staff is the sole responsibility of the governing body of each community.

Time Frame – The time frame was based on a combination of the priority for that measure, the complexity of the measure and whether or not the measure is conceptual, in design, or already designed and awaiting funding. Because the time frame for this plan is five years, the timing for all mitigation measures has been kept within this framework. The identification of a likely time frame is not meant to constrain a community from taking advantage of funding opportunities as they arise.

Potential Funding Sources – This column attempts to identify the most likely sources of funding for a specific measure. The information on potential funding sources in this table is preliminary and varies depending on a number of factors. These factors include whether or not a mitigation measure has been studied, evaluated or designed, or if it is still in the conceptual stages. MEMA and DCR assisted MAPC in reviewing the potential eligibility for hazard mitigation funding. Each grant program and agency has specific eligibility requirements that would need to be taken into consideration. In most instances, the measure will require a number of different funding sources. Identification of a potential funding source in this table does not guarantee that a project will be eligible for, or selected for funding. Upon adoption of this plan, the local committee responsible for its implementation should begin to explore the funding sources in more detail.

CITY OF BEVERLY HAZARD MITIGATION PLAN 2011 UPDATE

Additional information on funding sources – The best way to determine eligibility for a particular funding source is to review the project with a staff person at the funding agency. The following websites provide an overview of programs and funding sources.

Army Corps of Engineers (ACOE) – The website for the North Atlantic district office is <http://www.nae.usace.army.mil/>. The ACOE provides assistance in a number of types of projects including shoreline/streambank protection, flood damage reduction, flood plain management services and planning services.

Massachusetts Emergency Management Agency (MEMA) – The grants page <http://www.mass.gov/dem/programs/mitigate/grants.htm> has a useful table that compares eligible projects for the Hazard Mitigation Grant Program and the Flood Mitigation Assistance Program.

United States Department of Agriculture – The USDA has programs by which communities can get grants for firefighting needs. See the link below for some example.

<http://www.rurdev.usda.gov/rd/newsroom/2002/cfg.html>

Abbreviations Used in Table 16

FEMA Mitigation Grants includes:

FMA = Flood Mitigation Assistance Program.

HMGP = Hazard Mitigation Grant Program.

PDM = Pre-Disaster Mitigation Program

ACOE = Army Corps of Engineers.

MHD = Massachusetts Highway Department.

EOT = Executive Office of Transportation.

DCR = Department of Conservation and Recreation

DHS/EOPS = Department of Homeland Security/Emergency Operations

EPA/DEP (SRF) = Environmental Protection Agency/Department of Environmental Protection (State Revolving Fund)

USDA = United States Department of Agriculture

**CITY OF BEVERLY HAZARD MITIGATION PLAN
2011 UPDATE**

**Table 16
Potential Mitigation Measures**

Hazard Area	Mitigation Measure	Measure Type	Implementation Responsibility	Time Frame	Estimated Cost	Potential Funding Sources
High Priority						
A) Flooding	Chubb Brook	Structural Projects	DPW	2011-2012	\$971,740	FEMA/ Beverly
B) Flooding	Install a tide gate at the mouth of the Bass River.	Structural Projects	DPW	2011- 2013	\$300,000	FEMA/ Beverly
C) Storms/Multi-hazard	Purchase a new excavator and brush grapple. The PDM Team identified the need to clear brush and fallen tree limbs from streets and power quickly following high wind events as a top priority.	Emergency services	DPW	2011-2013	\$200,00	FEMA/Beverly
D) Flooding	Identify resources to maintain City drainage infrastructure on an ongoing basis.	Structural Projects and Maintenance	DPW	2011-2016	\$50,000 - \$100,00 per year	Beverly
E) NFIP Compliance	Floodplain Management	Prevention	Planning	2011- 2016	Ongoing	Beverly
F) NFIP Compliance	Maintain up to date maps of local FEMA identified floodplains.	Prevention	Planning	2011-2016	Ongoing	Beverly

**CITY OF BEVERLY HAZARD MITIGATION PLAN
2011 UPDATE**

Hazard Area	Mitigation Measure	Measure Type	Implementation Responsibility	Time Frame	Estimated Cost	Potential Funding Sources
G) NFIP Compliance	Acquisition of Vacant Flood Prone Lands	Natural Resource Protection	Conservation Commission	2011-2016	TBD	Beverly/DCR/Community Preservation Act
H) NFIP Compliance	Acquisition of Vacant Flood Prone Lands*	Natural Resource Protection	Conservation Commission	2011-2016	TBD	Beverly/DCR/Community Preservation Act
I) Multi-hazard	Acquire a new, towable, multi-phase, diesel generator.	Emergency Services Protection	DPW	2011-2013	\$25,000	Beverly/FEMA
Medium Priority						
J) Flooding	Install a tide gate/flapper valve on existing four foot drain line on the Bass River near the 103 Elliot Street commercial condominiums.	Property Protection	DPW	2013-2015	\$150,000	FEMA/Beverly
K) Storms	Replace approximately 6000- 8000 square feet of bottom-anchored floats at Beverly Harbor Center with concrete, pile-held floats	Property Protection	DPW	2013- 2015	\$1.5 million	Beverly
L) Storms/Coastal Flooding	Repair the Bay View seawall.	Property Protection	DPW	2013- 2015	TBD	FEMA/Beverly
M) Storms	Repair the eroded western coastal bank at Obear Park.	Property Protection	DPW	2013-2015	\$750,000	FEMA/Beverly

**CITY OF BEVERLY HAZARD MITIGATION PLAN
2011 UPDATE**

Hazard Area	Mitigation Measure	Measure Type	Implementation Responsibility	Time Frame	Estimated Cost	Potential Funding Sources
N) Storms/Coastal Flooding	Master Plan Update: Include a section on Climate Change and its potential impacts on Beverly in the next update of the Master Plan.	Property Protection	Planning	2011-2016	Ongoing	Beverly
O) Flooding	Purchase twelve, 2-inch submersible pumps for basement pump outs and other flood-related response efforts.	Emergency Services	DPW/Fire Department	2013- 2015	TBD	FEMA/Beverly
P) Brush Fires	Purchase .5 miles of new 1.5-inch forestry hose; new 4x4, 350 gallon, 2-ton woods fire truck; new hand held fire pumps	Property Protection	Fire Department	2013- 2016	TBD	FEMA/Beverly
Q) Earthquakes	Assess the earthquake vulnerability of all public buildings. Investigate options to make all public buildings earthquake-resistant.	Property Protection	Fire Department	2013-2016	Ongoing	Beverly

**CITY OF BEVERLY HAZARD MITIGATION PLAN
2011 UPDATE**

Hazard Area	Mitigation Measure	Measure Type	Implementation Responsibility	Time Frame	Estimated Cost	Potential Funding Sources
Lower Priority						
R) Multi-hazard	Purchase 50 new handheld radios for Fire Department	Property Protection	Fire Department	2013-2016	TBD	FEMA/Beverly
S) Multi-hazard	Replace current master fire alarm boxes with radio master box alarms.	Property Protection	Fire Department	2013-2016	\$3,000 each	FEMA/Beverly

**CITY OF BEVERLY HAZARD MITIGATION PLAN
2011 UPDATE**

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CITY OF BEVERLY HAZARD MITIGATION PLAN 2011 UPDATE

IX. PLAN ADOPTION AND MAINTENANCE

Plan Adoption

The Beverly Hazard Mitigation Plan was adopted by the City Council on February 6, 2012. See Appendix D for documentation. The plan was approved by FEMA on [ADD DATE] for a five-year period that will expire on [ADD DATE].

Plan Maintenance

MAPC worked with the Beverly Hazard Mitigation Planning Team to prepare this plan. This group will continue to meet on an as-needed basis to function as the Local Hazard Mitigation Implementation Group, with one City official designated as the coordinator. Additional members could be added to the local implementation group from businesses, non-profits, and institutions.

Implementation Schedule

Bi-Annual Survey on Progress– The coordinator of the Hazard Mitigation Implementation Team will prepare and distribute a biannual survey in years two and four of the plan. The survey will be distributed to all of the local implementation group members and other interested local stakeholders. The survey will poll the members on any changes or revisions to the plan that may be needed, progress and accomplishments for implementation, and any new hazards or problem areas that have been identified.

This information will be used to prepare a report or addendum to the local hazard mitigation plan. The Hazard Mitigation Implementation Team will have primary responsibility for tracking progress and updating the plan.

Develop a Year Four Update – During the fourth year after initial plan adoption, the coordinator of the Hazard Mitigation Implementation Team will convene the team to begin to prepare for an update of the plan, which will be required by the end of year five in order to maintain approved plan status with FEMA. The team will use the information from the year four biannual review to identify the needs and priorities for the plan update.

Prepare and Adopt an Updated Local Hazard Mitigation Plan – FEMA’s approval of this plan is valid for five years, by which time an updated plan must be approved by FEMA in order to maintain the City’s approved plan status and its eligibility for FEMA mitigation grants. Because of the time required to secure a planning grant, prepare an updated plan, and complete the approval and adoption of an updated plan, the local Hazard Mitigation Planning Team should begin the process by the end of Year 3. This will help the City avoid a lapse in its approved plan status and grant eligibility when the current plan expires.

At this point, the Hazard Mitigation Implementation Team may decide to undertake the update themselves, contract with the Metropolitan Area Planning Council to update the

CITY OF BEVERLY HAZARD MITIGATION PLAN 2011 UPDATE

plan or to hire another consultant. However the Hazard Mitigation Implementation Team decides to update the plan, the group will need to review the current FEMA hazard mitigation plan guidelines for any changes. The update of the Beverly Hazard Mitigation Plan will be forwarded to MEMA and DCR for review and to FEMA for approval.

Integration of the Plans with Other Planning Initiatives

Upon approval of the Beverly Hazard Mitigation Plan by FEMA, the Local Hazard Mitigation Implementation Team will provide all interested parties and implementing departments with a copy of the plan and will initiate a discussion regarding how the plan can be integrated into that department's ongoing work. At a minimum, the plan will be reviewed and discussed with the following departments:

- Fire / Emergency Management
- Police
- Public Works / Highway
- Engineering
- Planning and Community Development
- Conservation
- Parks and Recreation
- Health
- Building

Other groups that will be coordinated with include large institutions, Chambers of Commerce, land conservation organizations and watershed groups. The plans will also be posted on a community's website with the caveat that local team coordinator will review the plan for sensitive information that would be inappropriate for public posting. The posting of the plan on a web site will include a mechanism for citizen feedback such as an e-mail address to send comments.

**CITY OF BEVERLY HAZARD MITIGATION PLAN
2011 UPDATE**

X. LIST OF REFERENCES

In addition to the specific reports listed below, much of the technical information for this plan came from meetings with City department heads and staff.

FEMA Local Multi-Hazard Mitigation Planning Guidance, July 1, 2008

City of Beverly General Ordinances

City of Beverly Zoning Bylaw

City of Beverly, Subdivision Control Regulations

2002 Beverly Master Plan

2008 Open Space and Recreation Plan

Commonwealth of Massachusetts, MacConnell Land Use Statistics, 2005

Metropolitan Area Planning Council, Geographic Information Systems Lab

Metropolitan Area Planning Council, Regional Plans and Data

Individual interviews with Paul Cotter, Fire Chief and Mike Collins, Commissioner of Public Services and Engineering, October, 2010

**CITY OF BEVERLY HAZARD MITIGATION PLAN
2011 UPDATE**

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**CITY OF BEVERLY HAZARD MITIGATION PLAN
2011 UPDATE**

**APPENDIX A
MEETING AGENDAS**

**CITY OF BEVERLY HAZARD MITIGATION PLAN
2011 UPDATE**

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**CITY OF BEVERLY HAZARD MITIGATION PLAN
2011 UPDATE**



Don Boyce
DIRECTOR



Richard Sullivan
COMMISSIONER



Marc D. Draisien
EXECUTIVE DIRECTOR

**NORTH SHORE
HAZARD MITIGATION
PLANNING TEAM**

Beverly
Lynn
Nahant
Peabody
Revere
Salem
Saugus
Swampscott
Winthrop

THE COMMONWEALTH OF MASSACHUSETTS
Deval Patrick, Governor

MASSACHUSETTS EMERGENCY MANAGEMENT AGENCY
400 WORCESTER ROAD, FRAMINGHAM, MA 01702-5399 508-820-2000 FAX 508-820-1404

DEPARTMENT OF CONSERVATION AND RECREATION
251 CAUSEWAY STREET, SUITE 600-900, BOSTON, MA 02114-2104 617-626-1250 FAX 617-626-1351

METROPOLITAN AREA PLANNING COUNCIL
60 TEMPLE PLACE, 6TH FLOOR, BOSTON, MA 02111 617-451-2770 FAX 617-482-7185

North Shore Hazard Mitigation Planning Team

First Meeting

Monday, February 8, 10:00 AM

Saugus Public Safety Building
2nd Floor Training Room
27 Hamilton Street, Saugus, MA
(Map & directions attached)

AGENDA

10:00 WELCOME & INTRODUCTIONS

10:05 OVERVIEW OF HAZARD MITIGATION PLANNING & GRANTS

- State Hazard Mitigation Plan & FEMA Grants—Sarah White, MEMA
- Regional & Local Mitigation Plans - Martin Pillsbury, MAPC

10:20 UPDATING THE NORTH SHORE HAZARD MITIGATION PLAN

- FEMA Requirements & Grant Eligibility
- Review of Scope of Work & Schedule –MAPC
- Questions & Discussion – Local issues & Priorities

**10:50 GETTING STARTED: MAPPING AND CRITICAL FACILITIES DATABASE
FOR THE NORTH SHORE PLAN UPDATE**

- Susan Brunton, GIS Analyst, MAPC

11:15 NEXT STEPS / ADJOURN

If you have any questions please contact Martin Pillsbury at MAPC:
617-451-2770, ext. 2012 or mpillsbury@mapc.org

**CITY OF BEVERLY HAZARD MITIGATION PLAN
2011 UPDATE**

**Beverly Predisaster Mitigation Renewal Planning Meeting
August 2, 2010
Beverly City Hall
1 – 3 PM
Agenda**

1. Overview of Project Scope and Status. Chapter I
2. Introduce Beverly Hazard Mitigation Planning map series and digitized ortho photo. Identify Flood and Fire Hazard Areas and areas of future potential development. Ch III & Appendix B
3. Review and Assess Plan Goals. Ch IV
4. Review Existing Mitigation Measures. Ch V
5. Review Mitigation Measures from the 2005 Plan. Ch VI
6. Discuss Potential Mitigation Measures. Ch VII
7. Prioritize Mitigation Measures. Ch VII
8. Discuss Public Involvement and Outreach. Ch II
9. Next steps: 1) Finalize mitigation measures; 2) submit draft plan to Work Group for comment; 3) Conduct public outreach meetings with Planning Board and City Council; 4) Post on City website for public comment; 3) submit draft to MEMA and FEMA

Project Overview - MAPC received a grant to prepare natural hazards *Pre-Disaster Mitigation Plan* for the communities of Beverly, Lynn, Nahant, Peabody, Revere, Salem, Saugus, Swampscott and Winthrop. MAPC is working with the nine communities to update their plans to mitigate potential damages of natural hazards such as floods, winter storms, hurricanes, earthquakes and wild fires, before such hazards occur. The federal *Disaster Mitigation Act of 2000* requires that all municipalities adopt a *Pre-Disaster Mitigation Plan* for natural hazards in order to remain eligible for FEMA Disaster Mitigation Grants.

**CITY OF BEVERLY HAZARD MITIGATION PLAN
2011 UPDATE**

**APPENDIX B
HAZARD MAPPING**

The MAPC GIS (Geographic Information Systems) Lab produced a series of maps for each community. Some of the data came from the Northeast States Emergency Consortium (NESEC). More information on NESEC can be found at <http://www.serve.com/NESEC/>. Due to the various sources for the data and varying levels of accuracy, the identification of an area as being in one of the hazard categories must be considered as a general classification that should always be supplemented with more local knowledge. The documentation for some of the hazard maps was incomplete as well.

The map series consists of four panels with two maps each plus one map taken from the State Hazard Mitigation Plan.

Map 1.	Population Density
Map 2.	Potential Development
Map 3.	Flood Zones
Map 4.	Earthquakes and Landslides
Map 5.	Hurricanes and Tornadoes
Map 6.	Average Snowfall
Map 7.	Composite Natural Hazards
Map 8.	Hazard Areas

Map 1: Population Density – This map uses the US Census block data for 2000 and shows population density as the number of people per acre in seven categories with 60 or more people per acre representing the highest density areas.

Map 2: Potential Development – This map shows potential future developments, and critical infrastructure sites. MAPC consulted with City staff to determine areas that were likely to be developed or redeveloped in the future.

Map 3: Flood Zones – The map of flood zones used the FEMA NFIP Flood Zones as its source. For more information, refer to the FEMA Map Service Center website <http://www.msc.fema.gov>. The definitions of the flood zones are described in detail on this site as well. The flood zone map for each community also shows critical infrastructure and municipally owned and protected open space.

Map 4: Earthquakes and Landslides – This information came from NESEC. For most communities, there was no data for earthquakes because only the epicenters of an earthquake are mapped.

The landslide information shows areas with either a low susceptibility or a moderate susceptibility to landslides based on mapping of geological formations. This mapping is

CITY OF BEVERLY HAZARD MITIGATION PLAN 2011 UPDATE

highly general in nature. For more information on how landslide susceptibility was mapped, refer to <http://pubs.usgs.gov/pp/p1183/pp1183.html>.

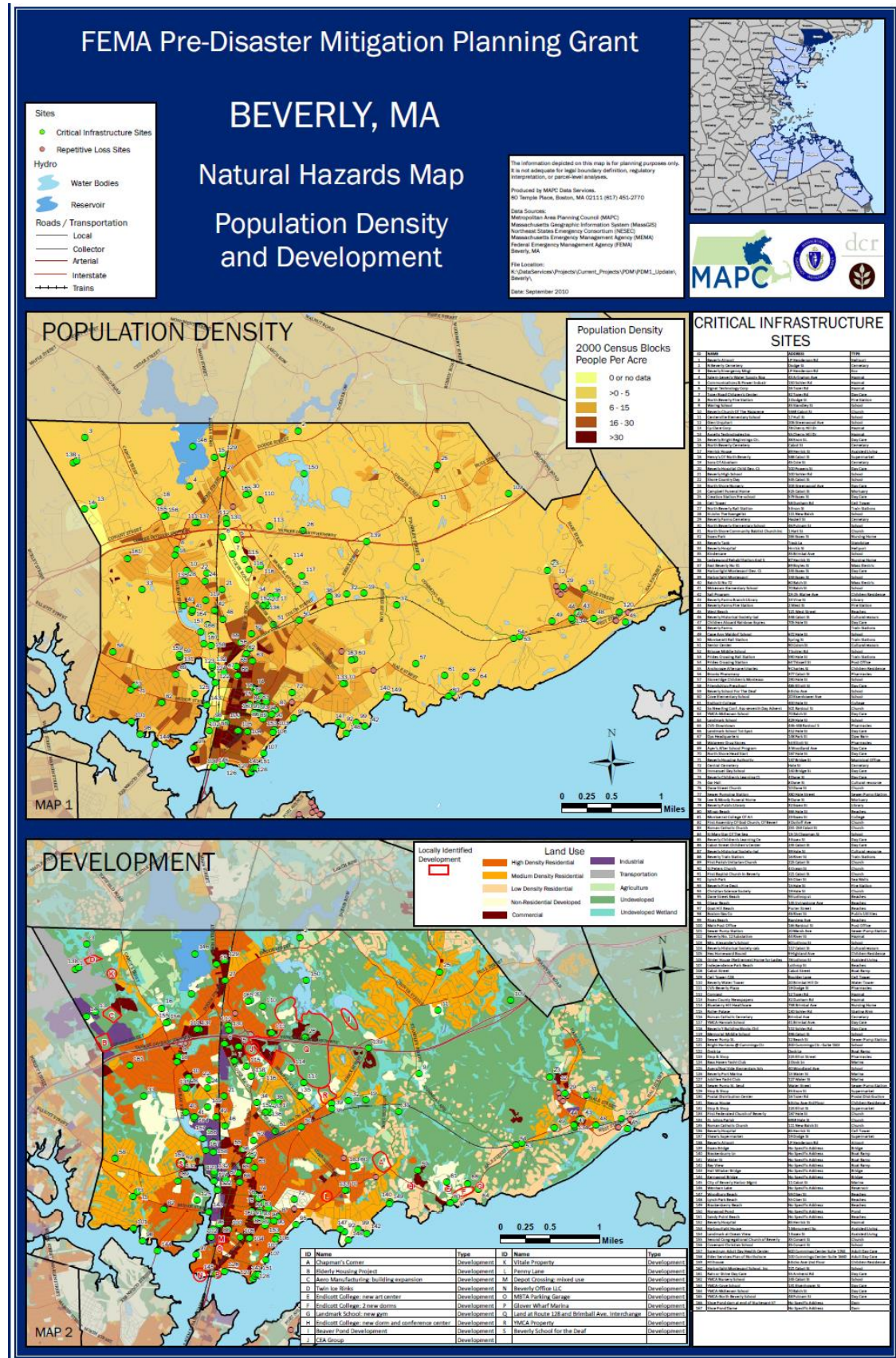
Map 5: Hurricanes and Tornadoes – This map shows a number of different items. The map includes the storm tracks for both hurricanes and tropical storms. This information must be viewed in context. A storm track only shows where the eye of the storm passed through. In most cases, the effects of the wind and rain from these storms were felt in other communities even if the track was not within that community. This map also shows the location of tornadoes with a classification as to the level of damages. What appears on the map varies by community since not all communities experience the same wind-related events. These maps also show the 100 year wind speed.

Map 6: Average Snowfall - - This map shows the average snowfall and open space. It also shows storm tracks for nor'easters, if any storms tracked through the community.

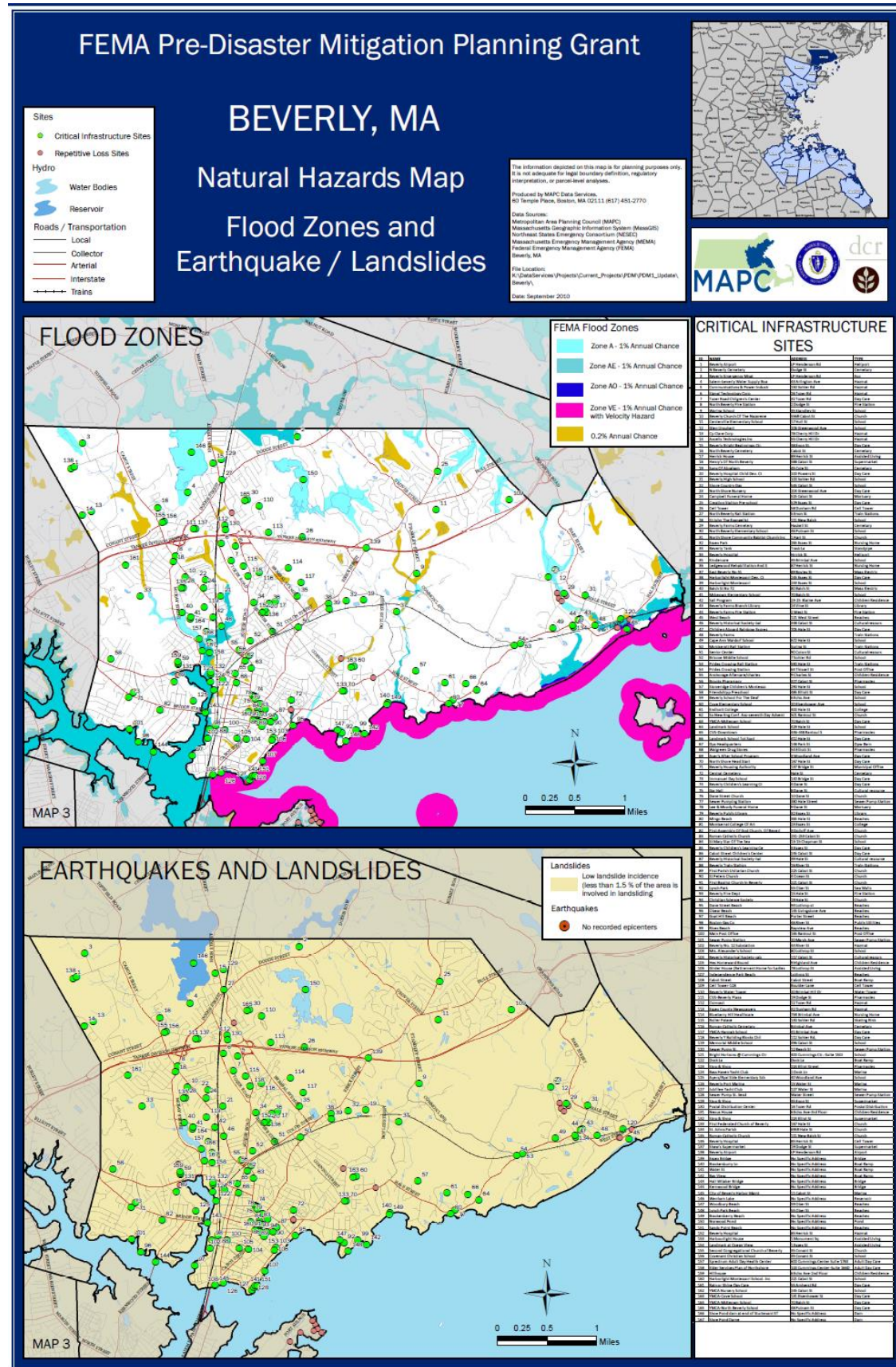
Map 7: Composite Natural Hazards - This map shows four categories of composite natural hazards for areas of existing development. The hazards included in this map are 100 year wind speeds of 110 mph or higher, low and moderate landslide risk, FEMA Q3 flood zones (100 year and 500 year) and hurricane surge inundation areas. Areas with only one hazard were considered to be low hazard areas. Moderate areas have two of the hazards present. High hazard areas have three hazards present and severe hazard areas have four hazards present.

Map 8: Hazard Areas – For each community, locally identified hazard areas are overlaid on an aerial photograph dated April, 2008. The critical infrastructure sites are also shown. The source of the aerial photograph is Mass GIS.

CITY OF BEVERLY HAZARD MITIGATION PLAN 2011 UPDATE



CITY OF BEVERLY HAZARD MITIGATION PLAN 2011 UPDATE



CITY OF BEVERLY HAZARD MITIGATION PLAN 2011 UPDATE

FEMA Pre-Disaster Mitigation Planning Grant



BEVERLY, MA Natural Hazards Map Hurricanes / Tornadoes and Average Snowfall

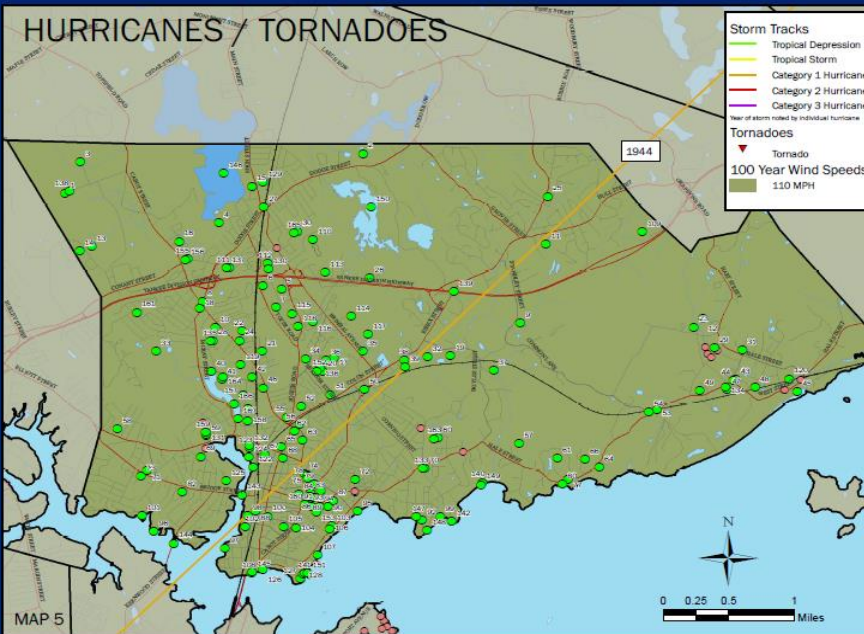
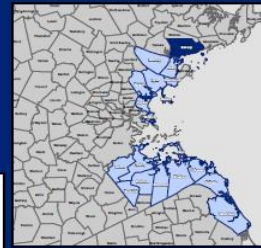
The information depicted on this map is for planning purposes only. It is not adequate for legal boundary definition, regulatory interpretation, or parcel-level analyses.

Produced by MAPC Data Services
40 Temple Place, Boston, MA 02111 (617) 451-2770

Data Sources:
Metropolitan Area Planning Council (MAPC)
Massachusetts Geographic Information System (MassGIS)
Northeast States Emergency Consortium (NESEC)
Massachusetts Emergency Management Agency (MEMA)
Federal Emergency Management Agency (FEMA)
Beverly, MA

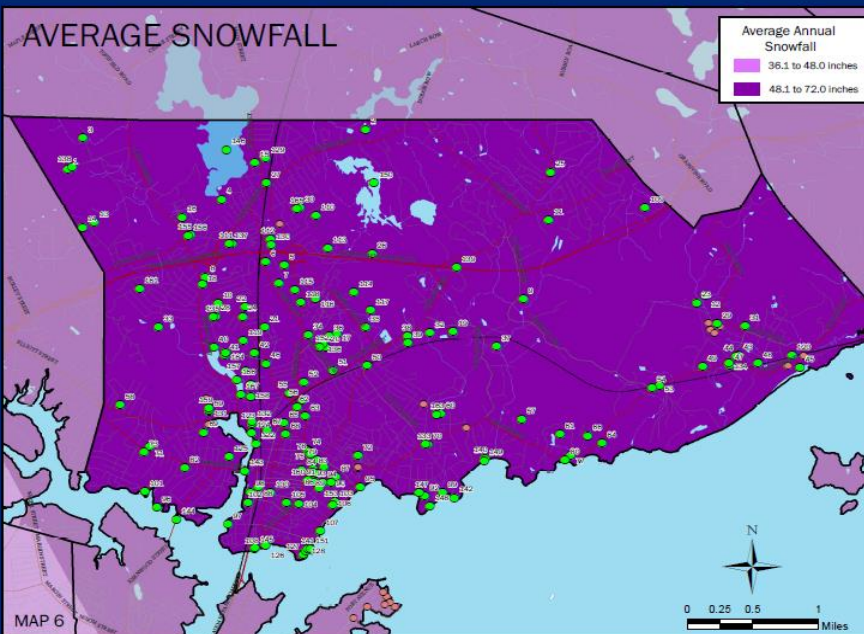
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Date: September 2010

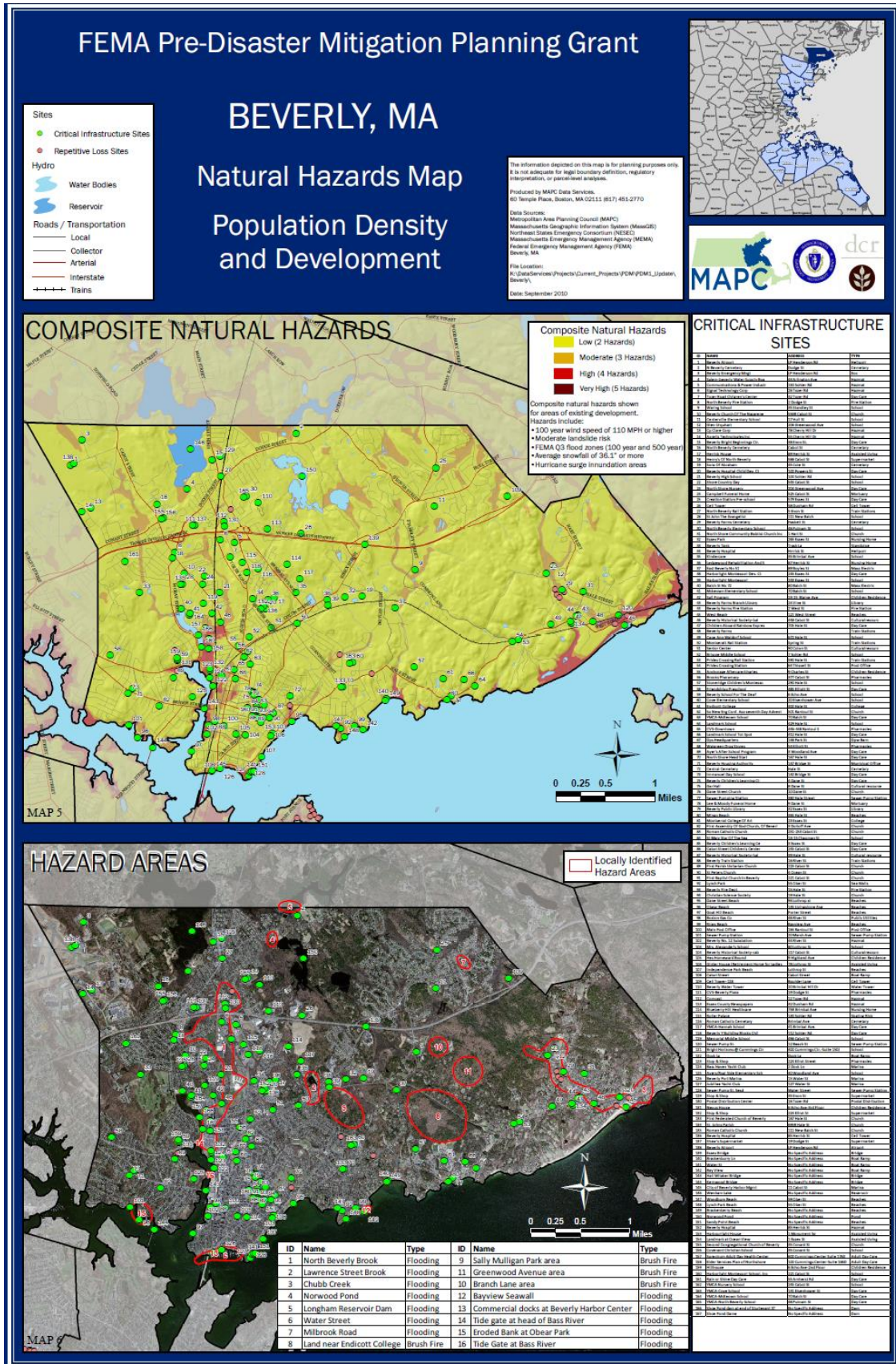


CRITICAL INFRASTRUCTURE SITES

ID	NAME	ADDRESS	CITY
1	Beverly Town Office	100 Temple Place	Beverly
2	Beverly Town Office	100 Temple Place	Beverly
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CITY OF BEVERLY HAZARD MITIGATION PLAN 2011 UPDATE



**CITY OF BEVERLY HAZARD MITIGATION PLAN
2011 UPDATE**

**APPENDIX C
DOCUMENTATION OF PUBLIC MEETING**

**CITY OF BEVERLY HAZARD MITIGATION PLAN
2011 UPDATE**

Beverly City Council 7:00 PM OCTOBER 18, 2010

Roll Call: Councilors Present: Judith A. Cronin, Patricia A. Grimes, Paul M. Guanci, James F. Latter, Donald Martin, D. Wesley Slate, Jr., Maureen Troubetaris, Michael P. Cahill
K. Hobin - ABSENT

Pledge of Allegiance to the Flag: Led by Councilor Guanci

Public Hearings and Public Speakers:

7:00 PM MAPC
Presentation - Disaster Mitigation Plan

7:10 PM Mary Roderick

7:15 PM Public Hearing - #175- Transfer of Funds for Building repairs

Refer to Finance and Property

Acceptance of Minutes:

Meeting of October 4, 2010

Presentations, Awards and Memorials:

#179

Resolution – Don Berman

Receive and Place on file

Appointments:

Communications from His Honor the Mayor:

#180

October 18, 2010

Honorable City Council
City Hall
Beverly, MA 01915

11/10/2010

**CITY OF BEVERLY HAZARD MITIGATION PLAN
2011 UPDATE**

**APPENDIX D
DOCUMENTATION OF PLAN ADOPTION**

**CITY OF BEVERLY HAZARD MITIGATION PLAN
2011 UPDATE**

CITY OF BEVERLY, MASSACHUSETTS

**A RESOLUTION ADOPTING A HAZARD MITIGATION PLAN FOR
THE CITY OF BEVERLY**

WHEREAS, the City of Beverly, Massachusetts established a Committee to prepare a Hazard Mitigation Plan; and

WHEREAS, the *Beverly Hazard Mitigation Plan* prepared by the Committee contains several potential future projects to mitigate potential impacts from natural hazards in the City of Beverly, and

WHEREAS, a duly-noticed public meeting was held by the Beverly City Council on October 18, 2010, and

WHEREAS, the City of Beverly authorizes responsible departments and/or agencies to execute their responsibilities demonstrated in the plan,

NOW, THEREFORE BE IT RESOLVED that the Beverly City Council adopts the attached Hazard Mitigation Plan, in accordance with M.G.L. 40 §4.

ADOPTED BY THE BEVERLY CITY COUNCIL AND SIGNED this Date: *February 6, 2012*

Paul M. Granger

Jason Silva

D. Scott Delle

Maurice E. Louchetain

Gregory Skidje

James F. Lee

Esther Haseman

Donald H. Martin

Brett Schiff

Kathleen P. Connolly, City Clerk

A TRUE COPY
ATTEST: *Kathleen P. Connolly*
City Clerk